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ABSTRACT

This summary of developments and activities at the University of Delaware Office of Computer-Based Instruction (OCBI) during 1980-1981 includes: (1) a detailed account of the history and development of OCBI which covers background information, utilization rates, the organization of OCBI, the OCBI courseware development process, OCBI publications, the training of OCBI users, OCBI participation in the Association for the Development of Computer-Based Instructional Systems (ACDIS), and the development by OCBI of peripheral devices for instructional purposes; (2) a set of descriptions of the activities undertaken by individual academic departments and offices at the University of Delaware which make use of computer-based instruction; (3) descriptions of the computer-based instructional services provided by OCBI to users outside of the University of Delaware; and (4) a description of the internal research and evaluation efforts undertaken by OCBI, including summaries of OCBI research projects concerned with student achievement, perceptual processes, alternative learning strategies, research tools, and organizational assessment. Included in the text of the report are 6 data table and 117 figures. A catalog of instructional, research, and utilities programs under development by OCBI is appended. (JL)

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SIXTH SUMMATIVE REPORT OF THE OFFICE OF COMPUTER-BASED INSTRUCTION

by

Fred T. Hofstetter

July 1, 1981

IR010252

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INTRODUCTION

On July 1, 1980 the name of the Delaware PLATO® Project changed. The new name is the Office of Computer-Based Instruction (OCBI). This new name reflects organizational developments in the administration of computer-based instruction at the University of Delaware.

The Delaware PLATO Project began as an experiment to determine the extent to which computer-based education could be used at the University. The first five summative reports record the results of this experiment as the number of terminals grew from one in 1975 to one hundred and eighty in 1980, and as the number of courses using PLATO increased to ninety offerings in twenty-six academic departments.

During the course of the Delaware PLATO Project the University acquired a highly trained staff that produces superior computer-based learning materials, and a model evolved for project management that involves both faculty and staff in a systematic approach to curriculum development. This model will continue in the Office of Computer-Based Instruction with the exception that it will no longer apply exclusively to the PLATO system.

When the experiment was planned in 1974 it was not known what system would be used. PLATO was found to be the best available system, and the experiment was called the University of Delaware PLATO Project. PLATO is still the best available system, and it will continue to provide a high quality of educational computing on the campus for many more years. As other systems are developed the OCBI may choose to demonstrate them as well and to implement them where appropriate. The first step in this direction has been the opening of a microcomputer classroom for teacher training. Microcomputers are also having an impact upon future plans of the OCBI, including MicroPLATO.

During 1980-81 the bulk of OCBI's work was with the PLATO system, and this Sixth Summative Report concentrates on the developments of the past year. More information on events of previous academic years can be found in prior summative reports available from the OCBI.

During 1980-81 new sites opened in Agriculture, Human Resources, Mathematics, and the Counseling Annex, and new projects started in Museum Studies, the Student Organization and Activities Center, the University Parallel Program, and the College of Urban Affairs. The number of terminals on campus increased to one hundred thirty-two, and the outside user base grew to ninety-six terminals. Two senior analysts were added to the staff in support of program development, and one middle-level analyst, four research associates, and one secretary were added to staff a new Center for Interdisciplinary Research in Computer-Based Learning (CIRCLe).

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Grants were received from the National Science Foundation for Leadership Training of Teachers in Computer-Based Mathematics Education, for the 1981 Summer Institute in Computer-Based Education, and for a Student Science Training Program for gifted high school students. NSF LOCI grants continued for courseware development in political science, biology, psychology, chemical engineering, and anthropology. The Department of Education renewed the New Castle County School District's PLATO grant and awarded a new grant for placing PLATO terminals in community centers of the Urban Coalition of Metropolitan Wilmington. The Control Data Corporation funded the development of a career guidance package, and Delaware became a participating institution in Control Data's pre-engineering courseware development project. The University's Inter-disciplinary Research Committee also funded an educational experiment whereby a research terminal was placed in the Downes Elementary School.

CIRCLe sponsored a well-attended faculty retreat on research in computer-based learning and started a new special interest group on theory and research in the Association for the Development of Computer-Based Instructional Systems (ADCIS). The Department of Mathematical Sciences organized a national consortium for computer-based mathematics education which also became a special interest group in ADCIS. This brings to four the number of ADCIS interest groups initiated at Delaware, with music in 1976 and human resources in 1979.

The OCBI also completed the design of the University of Delaware Sound Synthesizer (UDSS) which has 32 harmonics on each of four or eight voices with programmable control over waveforms, envelopes, tremolo, vibrato, and glissando. The UDSS is now offered for sale and can be purchased from OCBI.

The Sixth Summative Report is divided into four main divisions: history and development, University applications, outside user applications, and evaluation. Following these is an appendix which contains a catalog of courseware under development at Delaware.

CHAPTER I. HISTORY AND DEVELOPMENT OF THE OFFICE OF COMPUTER-BASED INSTRUCTION

Background

The Office of Computer-Based Instruction has its origins in deliberations of the University's Computer Applications to Education Committee during the fall of 1974. The committee planned a series of seminars and demonstrations for the purpose of making available to the Delaware faculty information on how a computer-based educational system may function in a university, and of evaluating what part such a system might play in the future of the University and its supporting community. A major portion of the committee's planning consisted of the review and selection of a computer-based educational system which could support the demonstration. The criteria used in making the selection provide a summary of the reasons why PLATO was chosen for the demonstration. They required that the demonstration system contain:

1. An overall system design which can support many instructional strategies such as gaming, simulations, testing, drill-and-practice, and self-paced programmed instruction.

2. An existing library of demonstration programs encompassing many academic areas.

3. A programming language which is both easy for faculty members to learn, and at the same time powerful enough to support instructional computing.

4. A student record-keeping capability to support educational research in learning behaviors.

5. High-speed interactive graphics for both textual and pictorial displays.

6. A very good overall system reliability.

With the installation of the first PLATO terminal on March 14, 1975, the Delaware PLATO Project began. A committee of faculty members selected from seventeen academic areas coordinated demonstrations of PLATO for each of the respective areas, encouraged interested faculty members to enroll in a seven-week seminar on author training, and solicited proposals from each college regarding the implementation of existing courseware and/or the development of new PLATO programs. By the end of May, nine departments had proposed to develop materials and try out PLATO with students.

During the summer of 1975 the proposals were approved, and the University ordered seven additional PLATO terminals to support program development. The first full-time professional PLATO programmer/analyst was hired to teach PLATO seminars and assist faculty members with difficult programming problems, and eight part-time student programmers were employed to help write programs for individual departments. The Project was held back somewhat by the amount of lead time needed to procure the additional PLATO terminals. One terminal was available right away, and was installed in September of 1975. However, the other six took longer to procure and were not installed until February of 1976.

This delay prevented large scale development of PLATO programs during the fall of 1975, when the two available terminals were used mainly for lesson review, demonstrations, author training, and planning the development of new material. During this period the faculty committee refined its PLATO proposals and made plans for the first large-scale use of PLATO with Delaware students to begin during the Fall Semester of 1976. On February 2, 1976, the committee submitted a proposal requesting the procurement of twenty-four terminals for student use. On April 28, 1976, this proposal was approved.

During the spring and summer of 1976, the faculty continued to prepare materials for student use. Utilization of the eight authoring terminals was high, averaging about sixty hours per terminal per week. PLATO continued to generate new interest, and by the beginning of the Fall Semester there were sixteen departments planning to use the student terminals. However, the Project was held back again because of the long lead time needed to order terminals and the care which had to be taken in negotiating a fair services contract for the University. In September the Project grew to a total of twelve terminals to support both development of programs and student use of PLATO during the Fall Semester of 1976. It was not until March 15, 1977, midway into the Spring Semester of 1977, that the Project reached the desired level of twenty-four student terminals and eight authoring terminals.

During the summer and fall of 1977, faculty members began to use PLATO in larger portions of their classes. In addition, the PLATO Project generated new interest in departments which had not previously used PLATO. The number of departments involved increased to a total of twenty-eight, and the average utilization of the thirty-two terminals exceeded sixty hours per terminal per week. In order to serve the dual purpose of reducing the level of frustration in getting to a PLATO terminal by lowering the average number of hours each terminal was used per week, and also to provide some growing room for the departments which had just begun using PLATO, it was decided to increase the number of terminals from thirty-two to fifty in preparation for the Spring Semester of 1978. Increasing the Project to a level of fifty terminals brought the University to a decision point regarding the future of the Delaware PLATO Project, because cost analyses had shown that once the Project grew to above forty-eight terminals it would become more economical for the University to purchase its own PLATO system than to lease services by means of long-distance communications lines. Based on the steady growth which the Project had enjoyed since its beginning in March of 1975, and based on the encouraging results from controlled evaluations and studies of student opinions regarding the usefulness of PLATO in higher education, the University of Delaware purchased its own PLATO system from the Control Data Corporation.

The University of Delaware Computing Center did an excellent job in preparing for the installation of the machine. A large area in the newly constructed Computing Center was designated for the PLATO system. Power generators were installed, a chilled water system was engineered, and the necessary electrical lines and pipes were put into place for the machine. The system was delivered at the University of Delaware Computing Center on January 31, 1978. After the machine was assembled, powered up, and run through a long series of performance tests and acceptance tests, it was officially accepted on St. Patrick's Day, March 17, 1978.

The Delaware PLATO system uses the latest line of computer hardware offered by the Control Data Corporation. Based on a Cyber 173 mainframe, it was initially configured to serve a load of 100 simultaneous PLATO users, with one central processor, ten peripheral processors, 98,000 60-bit words of central memory, 500,000 words of ECS-II (extended core storage), four dual-density disk drives, two tape drives, and two remote job entry stations.

During the 1978-79 academic year, the number of PLATO terminals on the Delaware campus was increased from 50 to 75, and the Project's outside user base also continued to grow, resulting in the need for enlarging the central system. On October 15, 1978, 32,000 60-bit words of central memory, 500,000 words of ECS-II, and 4 dual-density disk drives were added to the system resulting in a doubling of its capacity. During the 1979-80 academic year, the number of terminals in use on campus grew to 120, while the total number of terminals served by the system grew to 180. A second peripheral processing subsystem with 4 peripheral processors was added to the central system in order to handle increasing input-output needs.

In 1980-81 the one million words of ECS were replaced by two million words of extended semiconductor memory. Three peripheral processing units, a high speed tape drive system, and an 885 disk drive system were added to provide greater capacity for research, faster and more extensive backups, and room for new users. The number of terminals on campus increased to 132, bringing the total number connected to the system to 228.

The Delaware PLATO system is linked to a worldwide PLATO network which allows Delaware authors to exchange materials and ideas with other users on systems in Minnesota, Illinois, Quebec, Brussels, Alberta, and California. Figure 1 shows the hardware configuration of the Delaware PLATO system.

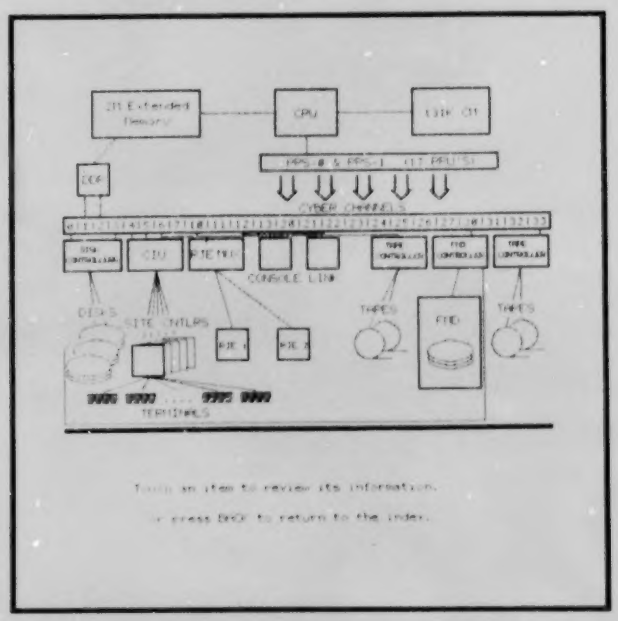


Figure 1. Delaware PLATO System Hardware Configuration, by Brand Fortner and David Anderer. Copyright © 1978 by the University of Delaware.

With the writing of the Fifth Summative Report on July 1, 1980, the demonstration phase of the Delaware PLATO Project was completed. No longer viewed as an experiment, PLATO is now considered to be a primary tool for research, development, and delivery of high-quality computer-based learning materials in University courses and in the educational programs of schools, businesses, and institutions in its outside user base. The organizational structure which evolved out of the PLATO Project has proven to be a highly effective way of managing a computer-based educational project. This structure will be used as a general model for project management in all of the University's computer-based educational efforts. The change in name from Delaware PLATO Project to Office of Computer-Based Instruction reflects the intent of the University to apply this structure not only to PLATO projects but also to computer-based education in general.

The PLATO system has been regarded since the early 1960's as the state-of-the-art in computer-based education, and even with the proliferation of other systems inspired by microprocessors in the 1970's, it still is the best system. However, other systems have found more widespread use in schools due to their lower cost and the courseware developed for them by conventional textbook publishers. As an East Coast teacher training site for computer-based education, the University has responded to these developments by installing a microcomputer classroom that contains a variety of microcomputers, courseware packages, and peripherals such as printers, synthesizers, slide projectors, and videodisc players. This classroom is being used in the Summer Institutes in Computer-Based Education for teachers, in the Summer Youth Campus for high school students, and in lifelong learning by the Division of Continuing Education. It is also being used as a benchmark laboratory for evaluating network strategies in the long-range planning of the OCBI. Systems currently represented in this microcomputer classroom include MicroPLATO, APPLE II$^+$, Atari 800, TI 99/4, Radio Shack's TRS-80, and Commodore's PET.

After a long series of demonstrations and evaluations of the microcomputers being used in schools today, APPLE was chosen as the primary system for the microcomputer classroom because of its widespread use, availability of courseware, and flexibility of design. The University gratefully acknowledges the receipt of a grant from Apple Computer Inc., whereby seven APPLE II$^+$ systems were added to the classroom bringing the total number of APPLEs available for teacher training to twenty-one. In addition to these, two APPLE II$^+$ systems are being used along with PLATO in the Mathematical Sciences Teaching and Learning Center that opened in the spring of 1981, and fourteen PETs are being used in physics.

Utilization

From the beginning there has been a steady rise in the utilization of PLATO terminals at the University of Delaware. Figure 2 shows the growth in terms of hours of terminal usage per quarter. Serious development of new programs began during the first two quarters of 1976. Utilization tripled during the 1976-77 academic year, when large-scale use by students began. It was at that time that the average utilization rose to over eighty hours per terminal per week. Additional interest shown in the PLATO system during the 1977-78 academic year produced a level of utilization which was almost twice that of 1976-77. During 1978-79, the level of utilization was fifty percent higher than that of the previous year. During 1979-80, usage was seventy-five percent higher, and in 1980-81, it was thirty-three percent higher than in the previous year.

Figure 2

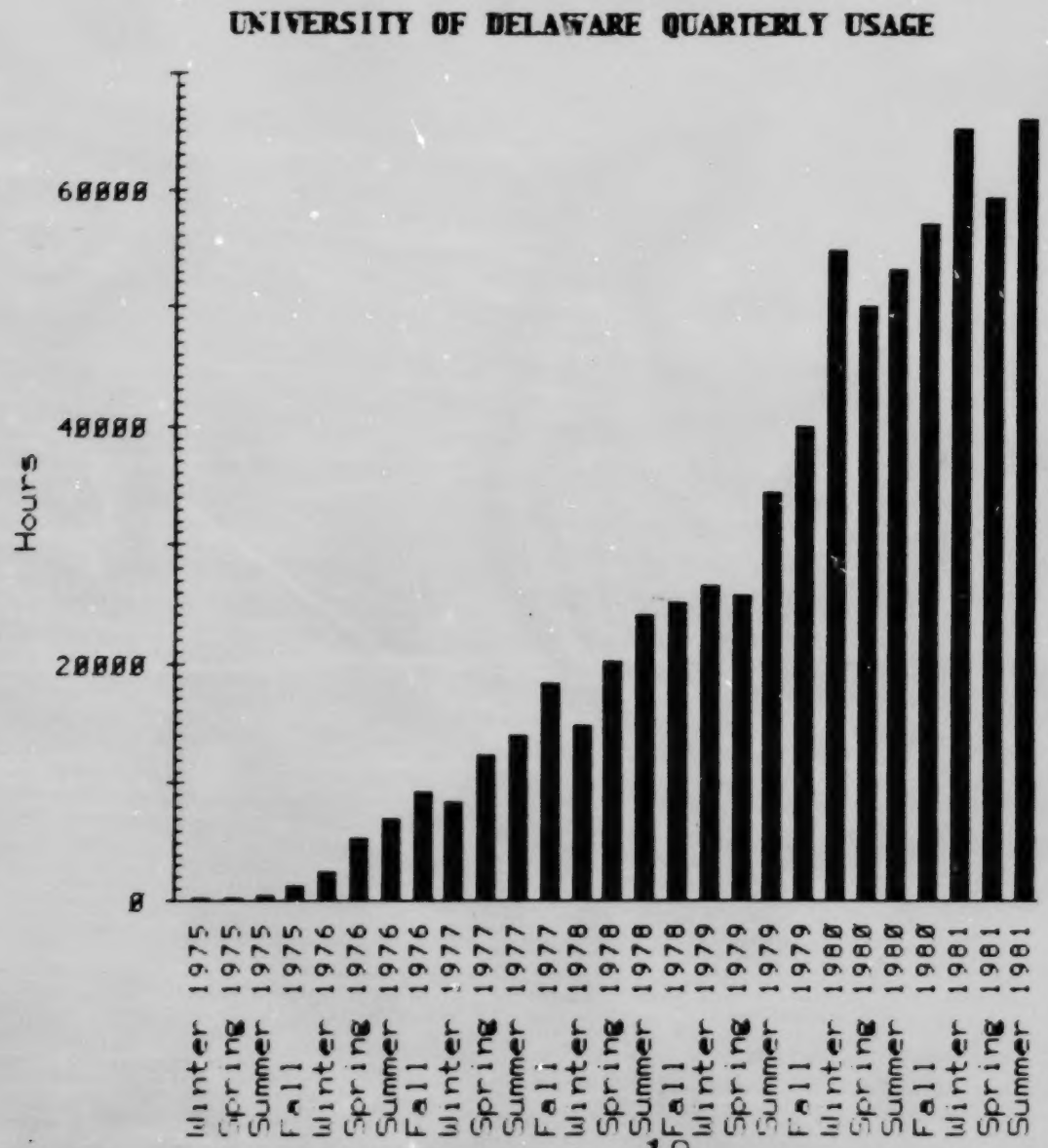


Table 1 shows how 112 courses used PLATO during the 1980-81 academic year. Column one gives the course symbol and number from the University's course catalog. Column two contains the descriptive title for the course. Column three gives the number of credits. Column four shows how many students used PLATO in the course. Column five gives the average number of hours each student used PLATO. The last four columns indicate whether the course used PLATO in the Summer Session, the first semester, the Winter Session, or the second semester. During 1980-81, 9287 students in 112 courses used PLATO. They accumulated a total number of 72,937 hours spent at PLATO terminals.

Twenty APPLE II^{+} systems and fourteen Commodore PETs were used in 1980-81 to deliver computer-based instruction on campus. Forty-two pre-college teachers in the Summer Institute in Computer-Based Education logged 2500 hours on the APPLEs while forty students in an astronomy course used instructional materials developed on the PET for a total of 12 hours.

Table 1

Courses Using PLATO During 1980-81

Course Symbol and Number		Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
						Summer	Fall	Winter	Spring
ACC	207	Accounting I	3	525	4.1		X	X	X
ACC	208	Accounting II	3	157	4.3		X		X
ACC	551	Financial Accounting	3	57	18.3		X		X
ALL	267	Word Power	3	57	16.2				X
ANT	101	Introduction to Social & Cultural Anthropology	3	105	1.9		X		
APS	133	Anatomy & Physiology of Domestic Animals	4	104	13.8		X		
APS	134	Anatomy & Physiology of Domestic Animals	3	96	9.5				X
APS	310	Animal Genetics Lab	1	25	3.3		X		
ART	201 400	Graphic Design Courses	3	96	9.9		X		X
BIO	115	Human Heredity & Development Lab	1	86	4.8				X
BIO	303	Genetics & Evolutionary Biology	4	189	7.1		X		X
C	100	Chemistry Human Environment	3	68	7.5		X		
C	101	General Chemistry	4	261	3.2				X
C	102	General Chemistry	4	130	3.0	X	X	X	X

Courses Using PLATO During 1980-81

Course Symbol and Number		Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
						Summer	Fall	Winter	Spring
C	103	General Chemistry	4	1070	3.6		X	X	X
C	104	General Chemistry	4	493	7.4	X	X	X	X
C	105	General Chemistry	3	196	10.0		X		
C	106	Elementary Bio-Organic Chemistry	5	7	.3				X
C	111	General Chemistry	3	109	7.1		X		
C	111	Honors: General Chemistry	3	49	3.2		X		
C	112	General Chemistry	3	11	.7				X
C	213	Elementary Organic Chemistry	4	73	5.2		X		X
C	214	Elementary Bio-chemistry	3	32	3.0	X			
C	331	Organic Chemistry	3	M*	6.8		X		
CE	211	Statics	3	13	1.0		X		
CHE	230	Introduction to Engineering Analysis	3	9	.6		X		
CHE	231	Chemical Engineering Thermodynamics	3	28	1.4		X		
CHE	345	Chemical Engineering Lab I	3	19	.6				X

* M means a multiple type sign-on was used. Number of students is unknown. Hours shown represent total hours.

Courses Using PLATO During 1980-81

Course Symbol and Number		Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
						Summer	Fall	Winter	Spring
E	Ø11	English Essentials	3	100	3.0		X		X
E	Ø15	Preparatory English	3	3	2.3		X		
EC	101	Introduction to Economics I	3	635	2.1		X	X	X
EC	102	Introduction to Economics II	3	164	1.7		X		X
EDD	342	Methods of Teaching Math	4	69	1.5		X		X
EDD	667	Summer Institute in Computer-Based Instruction	5	100	23.3	X			
EDS	667	Computers in Education	3	12	2.7		X		
EDS	829	Research on Teaching	3	6	.8		X		
EG	125	Introduction to Engineering	2	13	.9		X		
FR	101	Elementary French I	3	13	1.4		X		
FR	102	Elementary French II	3	71	2.7		X		X
FR	111	Intermediate French	3	107	9.8		X	X	X
FR	112	Intermediate French	3	23	2.0		X		X
FR	201	French Reading & Composition I	3	14	1.5				X
FR	401	Advanced French Grammar	3	19	1.4		X		
LAT	101	Elementary Latin	3	56	8.5		X		
LAT	102	Elementary Latin II	3	24	9.5				X

Courses Using PLATO during 1980-81

Course Symbol and Number		Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
						Summer	Fall	Winter	Spring
LAT	111	Intermediate Latin	3	6	3.2		X		
LAT	167	Individualized Elementary Latin	3	12	4.8		X		
M	115	Pre-Calculus	3	434	7.4		X		X
M	221	Calculus I	3	21	3.6		X		X
M	241	Analytic Geometry & Calculus A	4	23	2.3		X		
M	242	Analytic Geometry & Calculus B	4	9	3.3		X		
M	243	Analytic Geometry & Calculus C	4	26	2.3				X
MU	105	Fundamentals of Music	3	281	3.2	X	X		X
MU	185	Music Reading & Ear Training	2	60	18.0		X		
MU	186	Music Reading & Ear Training	2	50	10.3	X			X
MU	188	Basic Musical Experiences	3	92	2.5		X		X
MU	195	Music Harmony	3	76	6.3		X		
MU	285	Advanced Music Reading	2	33	13,7		X		
MU	286	Advanced Music Reading	2	30	9.8				X
N	201	Basic Instrumental & Expressive Functions in Nursing	5	178	2.0		X		X

Courses Using PLATO During 1980-81

Course Symbol and Number		Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization Summer	Fall	Winter	Spring
N	301	Nursing in Adult Physical Health and Illness	10	196	4.4		X		X
N	304	Nursing in Adult Mental Health	6	249	1.8		X		X
PE	120	Physical Education	1	15	2.4				X
PE	120	Racquetball	1	125	.8		X	X	
PE	120	Volleyball	1	75	1.8				X
PE	130	Introduction to Health, Physical Education & Recreation	1	M*	3.8		X		
PE	144	Skills/ Techniques Tennis/ Volleyball	1	83	1.7				X
PE	220	Anatomy & Physiology	3	61	2.3		X		X
PE	251	Skills/ Techniques Rhythm/ Dance	3	82	.8		X		
PE	324	Measurement & Evaluation	3	82	4.2		X		X
PE	367	Progressive Relaxation	3	M*	7.6		X		
PE	386	Tension Control & Relaxation	3	M*	6.3				X
PE	426	Biomechanics	3	77	5.4		X		X
PE	430	Physiology of Activity Lab	0	16	2.9				X
PE	620	Anatomy: Girdles & Extremities	3	6	1.4		X		

* M means multiple type sign-on was used. Number of students is unknown. Hours shown represent total hours.

Courses Using PLATO During 1980-81

Course Symbol and Number		Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization			
						Summer	Fall	Winter	Spring
PLS	101	Botany I	4	79	3.8		X		
PS	133	Introduction to Astronomy	4	13	1.5		X		
PS	134	Introduction to Astronomy	4	10	.7				X
PSY	201	General Psychology	3	51	1.2		X		
PSY	310	Sensation and Perception	3	23	.8		X		X
PSY	312	Learning and Motivation	3	63	1.2		X		X
PSY	340	Cognition	3	37	1.8				X
SOC	201	Introduction to Sociology	3	33	.5		X		
TDC	113	Textiles & Clothing in Contemporary Living	3	14	9.7	X			
TDC	211	Clothing 1a: Basic Processes	3	69	1.4		X		X
TDC	216	Clothing 1b: Advanced Processes	3	35	2.0		X		X
TDC	225	Architectural Drawing	3	47	.5				X
TDC	300	Consumer Economics	3	125	4.8	X	X		X
TDC	350	Personal Finance	3	37	1.7		X		
TDC	467	Clothing for Independent Living	3	8	1.0			X	
UA	804	Program Evaluation	3	4	2.3				X

Courses Using PLATO Spring 1980-81

Course Symbol and Number	Descriptive Title	Number of Credit Hours	Number of Students	Average Terminal Hours per Student	Time of Utilization Summer	Fall	Winter	Spring
UA 820	Population Urbanization & Community	3	14	1.7				X
LAT 166	Individualized Elementary Latin	1-6	22	5.9				X
LAT 766	Latin Workshop for Language Arts Teachers	3	16	1.6	X			

Courses Using PLATO During 1980-81
Non-Credit Use

PLATO Group	Descriptive Title	Number of Students	Average Terminal Hours per Student	Time of Utilization			
				Summer	Fall	Winter	Spring
CAREERS	Career Counseling	M *	100.3	X	X	X	X
CHAL 301	Credit by Exam for N 301	14	1.9				X
CHAL 406	Credit by Exam for N 406	4	3.4				X
DEMO	Independent Student Use & Demonstration	M *	4624.6	X	X	X	X
DPFORMAN	Introduction to Data Processing For Managers	18	2.9				X
INTROCOM	Introduction to Computers	24	4.2		X		X
MATH LAB I MATH LAB II	Pre-Calculus Math Review	42	9.4	X		X	
NSP	New Student Program	M *	497.4	X			
PROG 1/ PROG 2 SPONS 1/ SPONS 2 HSAUTH	TUTOR Programming for Pre-College Students	74	17.6	X	X	X	X
SEMINARS/SPRING	Beginning TUTOR Programming	161	23.8	X	X	X	X
SEXED	Sex Education	M *	4008.9	X	X	X	X
SOAC	Student Organ-ization & Activity Center	M *	18.6	X	X	X	X

*M means Mutiple type sign-on used. Number of students is unknown. Hours shown represent total hours.

Courses Using PLATO During 1980-81
Non-Credit Use

PLATO Group	Descriptive Title	Number of Students	Average Terminal Hours per Student	Time of Utilization			
				Summer	Fall	Winter	Spring
SSTP	Student Science Training Program	31	122.9	X			
SUSSEX	Demonstration Use by Parallel Program	M*	862.7		X	X	X
UDCE	Continuing Education ACCESS Center	M*	1840.7	X	X	X	X
UDELI	U.D. English Language Institute	176	9.3	X	X		X
UDGAMING	Group for Gaming Period	175	4.9	X	X	X	X
UDKIDS	Pre-College Student Use	M*	7349.9	X	X	X	X

*M means multiple type sign-on was used. Number of students is unknown. Hours shown represent total hours.

Organization

There are two main components in the organization of educational computing at Delaware, namely, faculty project leaders and centralized support staff. In each department using computer-based education there is a faculty member identified as "CBE Project Leader" who coordinates the setting of priorities and the allocation of resources within the department. To each department the OCBI provides programming support in the form of a part-time student programmer and/or a full-time professional.

The project leader serves as an intermediary between the OCBI staff and the rest of the faculty in the department. The project leader coordinates all CBE activities for the department, including evaluation. All final decisions regarding the content of CBE lessons are made by the project leader. Most project leaders use a peer review process whereby they obtain help from their colleagues in making these decisions. The energy, enthusiasm and dedication of the faculty has been a very important factor in the implementation of CBE at the University. Table 2 contains a list of the CBE project leaders.

A Faculty Committee on Computer-Based Instruction reviews CBE projects both at the proposal stage and after the first year of their development, and it can be asked by the Director of OCBI to review older projects as well. The members of this committee have been appointed to two-year terms as follows:

Michael Arenson, Music
David Barlow, Physical Education
Gerald Culley, Languages, Chairperson
Raymond Nichols, Art

The charge to this committee is as follows:

"The faculty committee on Computer-Based Instruction shall review new projects proposed by faculty members for feasibility, soundness of conception and design, and appropriateness to computer-based instructional techniques, and shall report its findings and recommendations to the Director of the Office of Computer-Based Instruction. It shall also review approved projects after one year to determine whether their initial promise is being realized, and it may undertake other reviews at the request of the Director of the Office of Computer-Based Instruction. To the extent that they find possible, the members shall offer advice and counsel informally to less experienced faculty members, at their request. The Committee shall review proposals to the Center for Teaching Effectiveness that involve computer-based instruction and make recommendations for support to the Associate Provost for Instruction."

As requests for the use of educational computing have increased, the University has developed a highly trained support staff. At the beginning of the PLATO Project the staff consisted of three graduate assistants. When the faculty's request for expansion to a level of eight PLATO terminals was approved in the summer of 1975, a senior applications programmer/analyst became the first professional staff member of the Project, and the number of student assistants was increased to eight. During the summer of 1976, in preparation for large-scale use of PLATO, a second professional programmer/analyst was hired, and the number of student assistants was increased from eight to twelve. During the winter of 1976-77, six of the student assistants demonstrated that they had met the qualifications for junior staff positions, and they were promoted to junior applications programmer/analysts.

Table 2

CBE Project Leaders at the University of Delaware

Projects	Project Leaders
Accounting	Jeffrey Gillespie
Agriculture	Paul Sammelwitz
Anthropology	Juan Villamarin
Art	Raymond Nichols
Biology	David Sheppard
Chemical Engineering	Roy McCullough/Stanley Sandler
Chemistry	John Burmeister
Civil Engineering	Eugene Chesson
Computer Science	Hatem Khalil
Continuing Education	Edwin Crispin/Jon Heggan
Counseling	Richard Sharf
Economics	Jeffrey Miller
Education -- Instruction	William Moody
Education -- Research	Victor Martuza/Richard Venezky
English	Louis Arena
Honors Program	Donald Harward
Health Education	Paul Ferguson
Human Resources	James Morrison
Institutional Research	Carol Pemberton
Languages	Gerald Culley
Library	Susan Brynteson
Mathematics	Ronald Wenger
Museum Studies	Barbara Butler
Music -- Aural Skills	Fred T. Hofstetter
Music -- Written Theory	Michael Arenson
Nursing	Carol Lillis
Physical Education	David Barlow/James Kent
Physics	Richard Herr
Political Science	Richard Sylves
Psychology -- Instruction	John McLaughlin/James Hoffman
Psychology -- Research	James Hoffman
Statistics	Victor Martuza
Student Center	Marilyn Harper
UD English Language Institute	Patricia Dyer
University Parallel Program	Jay Gil
Urban Affairs	Jeffrey Raffel

During the 1977-78 academic year four more student assistants demonstrated that they had met the qualifications for junior staff positions, and they were similarly promoted to junior applications programmer/analysts. In addition, three new professional analysts were hired from outside the University, two at the junior level, and one at the middle level. Two systems programmers were hired in order to coordinate system programming, operations, and communicatons for the new system. A second secretary was hired to handle the increased load of paper work in the Project. Finally, funds sufficient to hire one full-time operator were allocated to the University of Delaware Computing Center, which is operating the PLATO machine.

During 1977-78 it also became evident that the two senior staff members namely, James H. Wilson and Bonnie A. Seiler, had been taking on more and more of a supervisory role. In addition to overseeing the work of several junior staff members, they each had a major managerial component of the Project. Bonnie Seiler was in charge of lesson design, evaluation, and scheduling, and Jim Wilson managed the operations side of the Project. Recognizing the increased level of responsibility of these two staff members, two new managerial positions were created, and Bonnie and Jim were promoted to these positions effective July 1, 1978.

During the 1978-79 academic year, a senior electronics specialist was hired in order to coordinate maintenance for the growing number of PLATO terminals on campus, and a PLATO user services coordinator was hired to manage the Project's growing outside user base.

Several new positions were added to the Project during the 1979-80 academic year: a third manager to supervise all PLATO sites on campus and several academic projects, a peripheral design engineer to head the Project's hardware development component, a junior programmer/analyst to direct the new 17-terminal PLATO classroom in Drake Hall, an additional PLATO services consultant to provide additional on-line consulting, and three junior programmer/analysts to support new projects.

Recognizing the increasing activity and diversity of the Project, the staff structure was reorganized during the winter and spring of 1980. With promotions of Bonnie Seiler to Associate Director for Administration and of James Wilson to Associate Director for Operations, a new level of staff was formed called the "director's staff" consisting of the director, the assistant to the director, and the two new associate directors. Keith Slaughter and Judy Sandler were promoted to the senior staff to assume the managerial responsibilities formerly done by Bonnie Seiler and James Wilson.

When the PLATO Project evolved into the Office of Computer-Based Instruction on July 1, 1980, the organization was further expanded. A research component was added consisting of a professional coordinator and four graduate research assistants. Housed in the College of Education, this component is called the Center for Interdisciplinary Research in Computer-Based Learning (CIRCLe). Jessica Weissman was promoted to the senior staff to head the newly-formed Customer Courseware Development group. An additional PLATO services consultant and seven applications programmer/analysts were added during the year to support development projects.

As the staff grew an organizational structure evolved which proved to be a highly effective way of managing a computer-based educational project, and which will continue as the model for project management in the Office of Computer-Based Instruction. Figure 3 shows an overall organizational chart. The director of the OCBI reports to the Provost and receives recommendations from the faculty advisory committee. The OCBI consists of five main components, namely, operations, sites, user services, research, and campus program development.

Table 3 lists the staff of the Office of Computer-Based Instruction. The numbers given in column three are used to identify each staff member in the task assignment chart given in Figure 4. This chart shows which staff members are responsible for carrying out the many activities in the five components of OCBI.

Operational duties include the running of the Delaware PLATO system; the management of files such as instructional programs, utility routines, and work spaces in the computer memory; maintenance of terminals and peripheral equipment; data storage and transfer from PLATO to the University's computers and vice versa; printing of graphic displays, programming code, and data files as requested by users; programming of utility routines; on-line and off-line cataloging of all lesson materials available on the Delaware PLATO system; maintenance of PLATO data communications and hardware; diagnosis of needed improvements in PLATO software; research and development of new and existing equipment which would enhance PLATO services, such as music synthesizers, microprocessor interfaces, and floppy disk units; and the development of a microcomputer laboratory to support R&D efforts.

Each CBE site is watched over by an OCBI staff member who insures that the physical environment is conducive to student learning and to safe operation of the equipment. The site director also insures that the terminals do not use more than their proper allocation of computer resources. To date PLATO sites have been established in the Willard Hall Education Building, Smith Hall, Chemistry, the OCBI staff building at 46 E. Delaware Avenue, Music, the Math Center, Art, the Honors Center, Physical Education, Nursing, the Computing Center, Psychology, the Writing Center, Continuing Education, the Center for Counseling, Chemical Engineering, Human Resources, the Student Center, and the University Parallel Program in Georgetown. A microcomputer classroom was established in the Education building in 1981.

User support services include training seminars for campus users, especially prospective new authors; workshops and courseware development for off-campus users; CBE institutes for educators; consulting on programming, instructional design, and the PLATO Learning Management (PLM) system; assistance for off-campus users; special programs for pre-college students; instructional utility programs that can be used by many departments; and evaluation tools. The CBE Library consists of four main parts: first, printed materials, which include all available publications dealing with PLATO and significant publications by users of other systems; second, audio disks, which store up to twenty-two minutes of pre-recorded audio materials for use with PLATO's random access audio device; third, microfiche slides, which contain up to 256 slide images that can be rear-projected onto the screen of the PLATO terminals; and fourth, 35mm color slides of PLATO displays, facilities, and related materials which are used in demonstrations and other presentations.

Organizational Chart

Figure 3

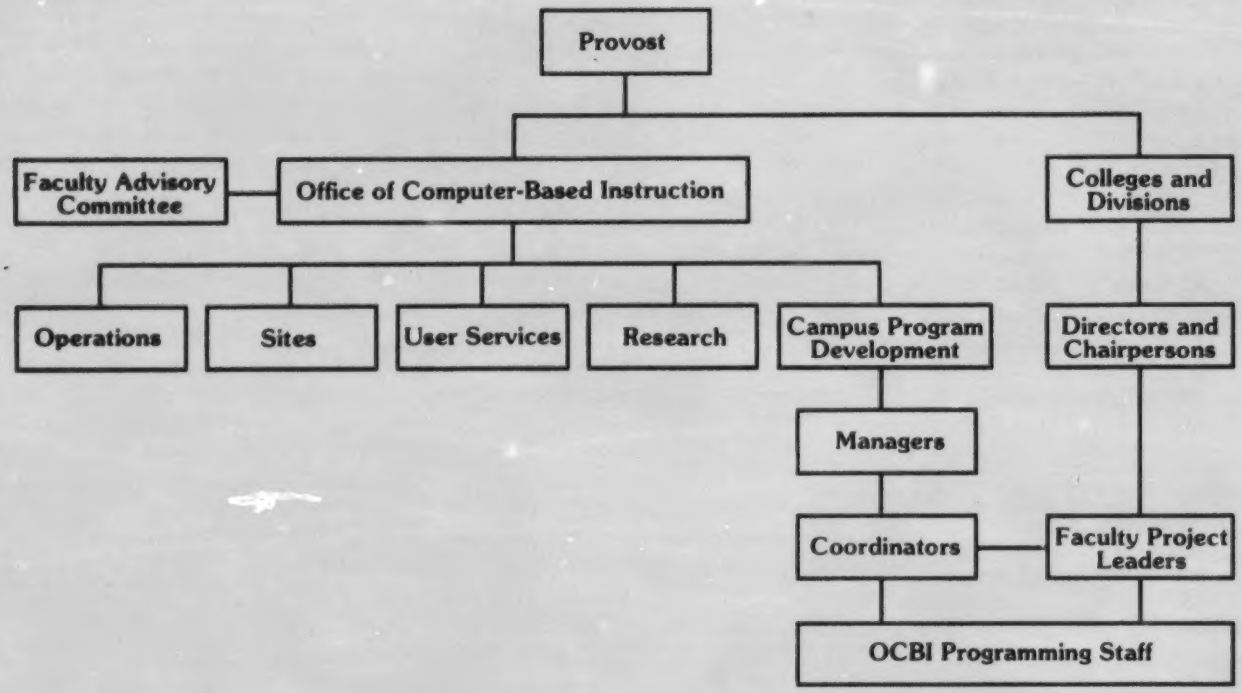


Table 3

Staff of the Office of Computer-Based Instruction

Position	Name	Number
Director	Fred T. Hofstetter	1
Assistant to the Director	Marianna K. Preston	2
Office Coordinator	Carol-Anne Ritter	3
Secretary	Charlotte Coletta	4
Secretary	Ruth Evans	5
Secretary	Diana Gemmill	6
Associate Director for Operations	James H. Wilson	7
Associate Director for Administration	Bonnie A. Seiler	8
Manager	Keith Slaughter	9
Manager	John Silver	10
Senior Applications Programmer/Analyst	Morris Brooks	11
Senior Applications Programmer/Analyst	Judy Sandler	12
Senior Applications Programmer/Analyst	Jessica Weissman	13
Systems Analyst	David Anderer	14
Systems Analyst	Charles Wickham	15
Peripheral Design Engineer	Robert Stradling	16
Senior Electronics Specialist	Linda Everett	17
Customer Service Specialist	Deborah Mellor	18
Applications Programmer/Analyst	Charles Collings	19
Applications Programmer/Analyst	William Lynch	20
Applications Programmer/Analyst	Dan Williams	21
PLATO Services Consultant	Roland Garton	22
PLATO Services Consultant	Carl Gill	23
PLATO Services Consultant	Rae Stabosz	24
Junior Programmer/Analyst	Patricia Bayalis	25
Junior Programmer/Analyst	Kathleen Bergey	26
Junior Programmer/Analyst	Louisa Bizoe	27
Junior Programmer/Analyst	Christine Brooks	28
Junior Programmer/Analyst	Ivo Dominguez Jr.	29
Junior Programmer/Analyst	Gary Feurer	30
Junior Programmer/Analyst	Michael Frank	31
Junior Programmer/Analyst	Sue Carol Garton	32
Junior Programmer/Analyst	Mike Houghton	33
Junior Programmer/Analyst	Kathy Jones	34
Junior Programmer/Analyst	Bob Krejci	35
Junior Programmer/Analyst	Carol Leefeldt	36
Junior Programmer/Analyst	George Mulford	37
Junior Programmer/Analyst	Mary Jac Reed	38
Junior Programmer/Analyst	Evelyn Stevens	39
Junior Programmer/Analyst	Amy Sundermier	40
Junior Programmer/Analyst	David Wiley	41
Graduate Assistant	Kenneth Kahn	42
Graduate Assistant	Patricia LeFevre	43
Graduate Assistant	William Lewis	44
Graduate Assistant	Bernice Shaeffer	45

Trainee Staff*	Clare Berrang	46
Trainee Staff	Lawrence J. Brewer	47
Trainee Staff	Donald Brill	48
Trainee Staff	Lawrence Carson	49
Trainee Staff	Carl Coleman	50
Trainee Staff	Corinne L. Conover	51
Trainee Staff	Cynthia Conroy	52
Trainee Staff	Sharon J. Correll	53
Trainee Staff	Stephen Cox	54
Trainee Staff	Brian Dear	55
Trainee Staff	Tuan Duc Duong	56
Trainee Staff	Clifton Fauntroy	57
Trainee Staff	Ronald Feldman	58
Trainee Staff	Michele Fino	59
Trainee Staff	Candace Ford-Kipp	60
Trainee Staff	Arthur L. Gaer	61
Trainee Staff	Kenneth Gillespie	62
Trainee Staff	Stephanie Gonzalez	63
Trainee Staff	Hu'ng Hang	64
Trainee Staff	Shawn Hart	65
Trainee Staff	Dipti Jain	66
Trainee Staff	Irving M. Jones	67
Trainee Staff	Samuel Lamphier	68
Trainee Staff	Monica Lapolt	69
Trainee Staff	Joan Lavallee	70
Trainee Staff	John J. Looney	71
Trainee Staff	James Mackin	72
Trainee Staff	Linda Mc Givern	73
Trainee Staff	Dawn A. Mosby	74
Trainee Staff	Kathy Neeson	75
Trainee Staff	Paul E. Nelson	76
Trainee Staff	Diann O'Reilly	77
Trainee Staff	Ronnie Ozer	78
Trainee Staff	Brenda Pasapane	79
Trainee Staff	Phyllis S. Patton	80
Trainee Staff	Richard K. Payne	81
Trainee Staff	Roxanne Pitts	82
Trainee Staff	Kenneth Polleck	83
Trainee Staff	Michael J. Porter	84
Trainee Staff	Mark D. Rassman	85
Trainee Staff	Diana Rector	86
Trainee Staff	George Reed	87
Trainee Staff	Mark Rogers	88
Trainee Staff	Bernard K. Russiello	89
Trainee Staff	Mary Lisa Ryan	90
Trainee Staff	Barry Schwarz	91
Trainee Staff	Andrew Semprebon	92
Trainee Staff	Karen Sims	93

Trainee Staff	Randall Smith	94
Trainee Staff	Paul Steiner	95
Trainee Staff	Leonid Vishnevetsky	96
Trainee Staff	Bradford Weir	97
Trainee Staff	Ben E. Williams	98
Trainee Staff	Michael Winters	99
Trainee Staff	Mark Zembrzuski	100

Trainee Staff	Joseph Ayres	101
Trainee Staff	John Beyer	102
Trainee Staff	Brooks Cooley	103
Trainee Staff	Jeffrey Davis	104
Trainee Staff	Cheinan Marks	105
Trainee Staff	Tina Rosenwald	106
Trainee Staff	Raymond Skillman	107
Trainee Staff	Jeffrey Snyder	108
Trainee Staff	Christopher Vinson	109

*Trainee Staff are miscellaneous wage earners. Twenty-eight of these are work-study students. Trainee Staff listed below the dotted line are funded all or in part by departments other than the Office of Computer-Based Instruction.

TASK ASSIGNMENT CHART

Figure 4

OPERATIONS D7

Communications 14,15
Data Storage/Transfer 15
Hardware Construction 16,83
Hardware Programming 14,15,16
Hardware Research 16
Maintenance 17,48
Microprocessors 10,22,23
MicroTUTOR Conversion 22,41
Operator Training 14,15
PLATO Courseware 14,18
PLATO Software 14,15
Printing 14,54,109
Publishing 2,3,10,13
Resource Management

SITES D7,D8,M10

Agriculture 35
Art 36
Chemical Engineering 21
Chemistry Classroom 36,67
Computing Center 15
Continuing Education 19
Counseling Center 19
Educational Research 30
Honors Center 28
Human Resources 26
Math Center 11
Music 20
Nursing 39
OCBI Office 23
Physical Education 25
Psychology 31
Smith Classroom 29,80
Student Center 25
Universty Parallel Program 28
Willard Classroom (009) 35,90
Willard Demonstration Room (203) 35
Writing Center 29

USER SERVICES D7,D8

CBE Library 6,9,13,20,21
Classroom Assistance M10,24,35,36,47,49,51,52,58,59, 63,66,67,69,70,75,77,82,85,86,90,95,97,99
Consulting M9,10,21,22,23,24
Customer Courseware Development M13,26,33,55,72
Customer Services 18,32,71
Design Consulting 13
Evaluation M10,36
Instructional Utilities M9,40
Office Support 56,73,96
PLATO Learning Management System M13,87
Pre-college Programs M12,28,46
Seminars/Workshops/Institutes M9,13,22,23,24
Staff Orientation M12,108

RESEARCH D8,M12

Colloquia and Conferences 30,44
Grant Proposals 30,43
Research Library 30,42,43,45
Statistical Evaluation 30,42,43,45

CAMPUS PROGRAM DEVELOPMENT D8

Accounting M10,C35,62,64
Agricultural Economics M9,C36
Agricultural Engineering M10,C27
Agriculture M10,C35,84
Anthropology M9,C28,68,93
Art D7,C36,54,98
Biology M9,C38,102,103
Chemical Engineering M12,C21,91,92,101,104
Chemistry M10,C36,89,96
Civil Engineering M12,108
Computer Science M10,C26
Continuing Education M9,C19
Counseling M9,C19,27,34
Economics M9,C37,64,100
Educational Instruction M12,C28,74
Educational Research M12,C30,78
Health Education M10,C25,106
Honors Program M9,C28
Human Resources M12,C26,60,80
Institutional Research M9,C38
Languages M12,C37,21,79
Math M9,C11,81,88
Museum Studies M13
Music (aural) M9,C20,61
Music (written) M9,C20,57,76
Nursing M9,C39,107
Physical Education M10,C25,53,65
Political Science M12,C32,42,94
Psychology Instruction M12,C35,46,105,109
Psychology Research M10,C31
Statistics M9,C30,38
Student Center M10,C25
U.D. English Language Institute M12,C28
University Parallel Program M12,C28
Upward Bound M12,C29
Urban Affairs M12,C36
Writing Center M12,C29,50,108

D - Associate Director in Charge
M - Manager in Charge
C - Coordinator of Project

Numbers refer to column 3 of Table 3.

The research activities of OCBI are coordinated by CIRCLe, which sponsors colloquia and conferences, maintains a comprehensive library of research materials in CBE, and assists faculty members in writing research proposals and in evaluating the effectiveness of CBE instruction.

The thirty-six campus program development projects are managed by members of the senior staff. Each departmental team of faculty members, coordinators, and programmers is supported by a manager who both advises the team members as the lessons develop and helps them set appropriate goals and target dates.

Courseware Development Process

Nievergelt* has pointed out that "Today it makes no sense to start a CAI project unless one is willing to write most of the necessary courseware." Whereas this is not true for every subject, it was recognized by the faculty committee in 1974 that although good examples of the use of PLATO could be found in existing program libraries, there were many new applications which needed to be explored, and therefore a heavy emphasis upon program development was planned. Figure 5 shows the present state of the evolution of the Delaware model for courseware development. Using a systems approach it contains a proposal stage, a design stage, a programming stage, and a dissemination stage. It departs from the traditional systems approach in that it does not contain a separate evaluation stage; rather, evaluation is incorporated throughout the model in a variety of feedback loops.

The process begins with the proposal stage, in which the faculty member works with one of the OCBI managers to develop a written plan for courseware development. The plan addresses the student need that would be met by each lesson; justifies the use of CBE for this application; describes campus use, evaluation, and publication plans; and projects the need for programming support. The Faculty Committee on CBI then helps the faculty member refine the proposal if necessary and recommends it to OCBI stating any special conditions which may apply. Once the proposal has been funded, a coordinator and a student programmer are allocated to the new project, forming with the faculty member a development team.

During the design stage, the team plans each lesson in detail and works out the design, display by display, in the form of a paper script. Teams are encouraged to submit the lesson to a Lesson Review Seminar while ideas are on paper and not yet in the computer, so that suggestions can be incorporated before hours of programming effort have been expended.

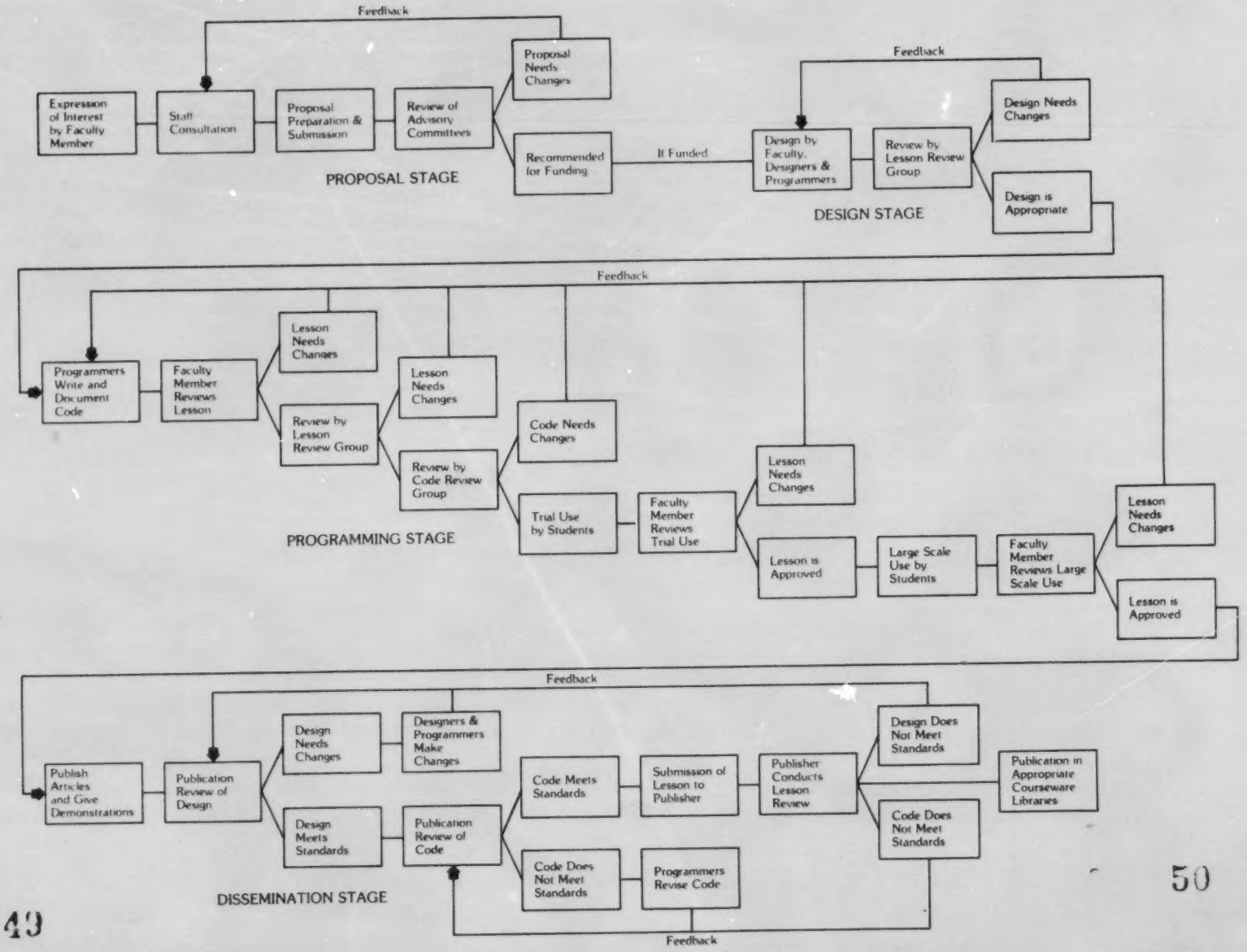
The team revises the lesson script based on reviewers' suggestions, and the lesson progresses to the programming stage. Revisions in the design continue to be made by the team as the programmer begins to put the lesson on line under the coordinator's supervision. The design of the lesson is often reviewed again when much of it has been implemented on line. After the programming is completed, the programmer has the lesson code reviewed in a Code Review Seminar in order to improve the programming techniques and documentation in the lesson. The lesson is further refined as trial use by students provides feedback as to the lesson's strengths and weaknesses.

After the lesson has been successfully used by students on a large scale and has been incorporated into a curriculum, it is ready for the dissemination stage. Faculty members are encouraged to publish articles about the lesson materials developed and to demonstrate them to colleagues both on and off campus. Each lesson goes through OCBI's publication review process that includes a Publication Lesson Review and a Publication Code Review. In these reviews, the lesson is checked by a senior OCBI staff member to make sure it meets the publisher's standards as well as those of OCBI, which are often more stringent. The lesson is then submitted for publication and distribution to other CBE sites.

*Jurg Nievergelt, "A pragmatic introduction to courseware design," IEEE Spectrum, September, 1980, pp. 7-21.

Figure 5

The Delaware Model for Courseware Development



Publication

As described above in the section on OCBI's Courseware Development Process, the last stage in lesson development includes publication. The University of Delaware has a contract with the Control Data Corporation which deals with the publishing of PLATO lessons written at Delaware. After the lessons pass the code reviews and lesson reviews included in the Delaware Model for Courseware Development, copyrights are secured, and the lesson authors fill out publication forms that are submitted with the completed lesson materials to Control Data. Once the lessons pass Control Data's technical and mechanical review process, they are published and made available to all PLATO users.

During the 1979-80 academic year two Latin lessons were published under this contract with Control Data, namely, "Cursus Honorum" and "The Verb Factory," authored by Professor Gerald Culley. Lessons submitted for publication in 1980-81 are listed with their lesson authors in Table 4.

Table 4

Lessons Submitted for Publication in 1980-81

Lesson Titles	Lesson Authors
GUIDO Intervals Melodies Chords Harmonies Rhythms	Hofstetter, Lynch
Exploring Careers	Sharf, Collings, et al.
Volleyball	Viera, Markham
Hang-a-Spy	Weissman
What is Break-Even Point?	Di Antonio, Bizoe

Instructor and Author Training

Since the installation of the first PLATO terminal at the University, a series of seminars has been offered four times a year in order to provide members of the University community and Delaware teachers with an opportunity to learn about various aspects of the PLATO system. There is a short orientation seminar for those who want a brief overview, a sequence of two courses in programming in the TUTOR language, two courses in lesson design, a lesson review seminar, a programming review seminar, seminars on special purpose lesson packages and other topics of current interest, and, recently added, a seminar on the programming of the microcomputer which is part of the architecture of most PLATO terminals. These non-credit seminars are offered free of charge to members of the University of Delaware community and to Delaware teachers.

Because of the success which these seminars have demonstrated in producing competent PLATO authors, and in response to the need for a national training program for PLATO authors, the Office of Computer-Based Instruction offers the same training curriculum in a revised, modular format of intensive workshops for those outside the University who are interested in PLATO training. Participants may select a one-week or two-week training period. One-week registration allows participants to choose three modules from the training curriculum. Two-week registration allows participants to study five modules. A brochure with more information regarding this training program is available from the Office of Computer-Based Instruction. Table 5 shows a list of modules in the training curriculum.

Table 5

Training Curriculum for Users and Authors

1. Introduction to the PLATO System. General purposes and uses of the PLATO System are presented. Instructional materials are demonstrated to illustrate PLATO's special features, such as the touch-sensitive screen, the music box, the random-access audio device, and the speech synthesizer. This module will help participants establish guidelines for the use of the PLATO system in their respective fields.

2. Orientation for Instructors. Guidelines for integrating PLATO materials into the participants' learning environment are detailed. Topics include viewing PLATO's library of instructional materials, organizing PLATO materials into a curriculum, setting up student rosters, collecting student-usage data, and using PLATO's communication features. This module provides a valuable opportunity to learn how to individualize instruction.

3. Beginning TUTOR Programming. For those with little or no background in computer usage, this module offers the fundamentals of TUTOR, the language of the PLATO system; included is guided practice at a PLATO terminal.

4. Advanced TUTOR Programming. For those with some prior knowledge of TUTOR, this module covers advanced topics in PLATO programming, tailored to participants' individual programming needs.

5. PLATO Lesson Design. This module presents guidelines for designing computer-based educational materials on the PLATO system. Emphasis is placed on the advantages and disadvantages of a variety of instructional styles, plus work on basic display techniques, response handling, and individualizing instruction.

6. PLATO Lesson Review and Critique. This module, designed to help authors improve the instructional materials they are developing, involves informal review and critique of one another's lessons, and the sharing of design techniques.

7. TUTOR Programming Review and Critique. This module involves informal review and critique of TUTOR programming techniques used by participants. Lessons are reviewed for readability, documentation, and efficiency. This module provides participants with an excellent opportunity to improve their authoring skills.

8. Site Management Training. Designed for those who manage a PLATO site, this workshop emphasizes how to use PLATO "site director options" to run an efficient PLATO site. Topics covered include PLATO hardware components; system resources such as extended memory, disk space, and computer time; and how to allocate resources among users.

9. PLATO Computer-Managed Instruction (CMI). Designed to teach participants to use the PLATO Learning Management (PLM) package, this workshop demonstrates the use of the PLATO system for computer-managed instruction. It utilizes instructor-specified objectives, test items, mastery criteria and multimedia instructional materials. Topics include the use of PLM to individualize instructional programs, to create competency-based courses, and to set up study/review materials.

10. MicroTUTOR Programming. This module will introduce participants to MicroTUTOR, the language of the microprocessor in programmable PLATO terminals. Topics covered will include judging, dual processing, conversions and floppy discs.

A growing number of teachers from Delaware's public schools have become interested in using PLATO in the classroom. In response to their requests for an opportunity to learn more about computer-based education, a Summer Institute in Computer-Based Education was held during July of 1976. Jointly funded by the University and the Delaware School Auxiliary Association, the institute offered instruction on PLATO and on Project DELTA, a minicomputer-based system with terminals in many of Delaware's high schools. In addition, all participants attended a seminar to discuss issues raised in the book by Hunter et al., Learning Alternatives in U.S. Education: Where Student and Computer Meet (Englewood Cliffs: Educational Technology Publications, 1975).

A second Summer Institute in Computer-Based Education was held from July 24 through August 11, 1978, jointly funded by the National Science Foundation and the Delaware School Auxiliary Association. Ninety-six teachers from the tri-state area attended this institute and studied the history of computer-based education, programming of the DELTA system and the PLATO system, instructional design of computer-based materials, as well as instructional applications of computers in art, chemistry, mathematics, music, physics, and social science.

A similar Summer Institute was funded by the National Science Foundation and was held July 23 through August 10, 1979. In addition, the Delaware School Auxiliary Association provided funds for a second 1979 Summer Institute to serve computer-based training needs of teachers of agriculture, biology, business, and economics.

In 1980, a fifth Summer Institute was funded by the National Science Foundation. In recognition of the growing use of personal computers in elementary and secondary schools, presentations on the APPLE II, TRS-80, PET, and TERAK personal computers were added to the 1980 Summer Institute. Also added were faculty lectures on the instructional applications of computers to biology and psychology.

In 1981, the National Science Foundation funded a sixth Summer Institute for ninety-six teachers of 5th-12th grade biology, chemistry, economics, mathematics, physics, and psychology from the states of Virginia, Maryland, Ohio, Delaware, Pennsylvania, New Jersey, New York, Connecticut, and Rhode Island. Recognizing the widespread use of microcomputers in schools, the University installed a microcomputer classroom for use by Institute participants. Teachers had their choice of learning BASIC on the APPLE II^{+} microcomputer or of learning TUTOR on PLATO. All of the participants had access to both PLATO and APPLE systems during the three weeks of the Institute.

Participation in the Summer Institutes has reaped several benefits for area teachers. Many have gone on to evaluate, develop, test, and implement computer-based instructional materials in their respective schools. Some have been motivated to pursue advanced degree programs with concentrations in computer-based education. A few have taken part-time jobs in order to obtain on-site training in the methods and uses of Computer-Based Education. Three of those originally employed part-time have become full-time professionals in the Office of Computer-Based Instruction. In turn, the University has learned much about what instructional needs in middle school and high school environments may be met through computer-based techniques.

Lesson Review

New users usually begin their orientation to PLATO by reviewing some of the more than 4000 hours of lesson materials that already exist on the PLATO system. The ever-increasing PLATO lesson library is organized into twenty-seven subject matter catalogs and is accessible from any PLATO terminal. In addition, comprehensive written guides to lesson materials are available in the OCBI library which will be moving to the Academy Building during the summer of 1981.

Potential users may review PLATO lessons in their field in order to consider them for use by their students and/or to provide ideas for new lessons. Ideas for PLATO applications in one's own subject can also come from looking at lessons in other subjects.

Another early step in becoming acquainted with the features of the PLATO system involves trying various terminal accessories such as the random access audio device, which presents pre-recorded messages; the four-voice music synthesizer; the Votrax digitized speech device; and the random access slide projector.

In order to facilitate the review of lessons by faculty, staff, students, and visitors, a special "demonstration" sign-on has been created which gives all users immediate and easy access to the lessons on PLATO. Instructions for using this sign-on are illustrated in Figures 6 and 7. First when PLATO asks for your name, type "demo," as shown in Figure 6, then press the NEXT key. Second, when PLATO asks for your group, type "demo," as shown in Figure 7, then hold down the SHIFT key while pressing the STOP key. PLATO will display an index which will let you access most of the instructional materials on PLATO. This index is shown in Figure 8. Reviewers can try a lesson by typing the appropriate letter from the index.

Four PLATO lessons have been written specifically to orient new users to the Delaware PLATO System. They include: "How to Use PLATO," which teaches the new user how to operate the terminal; "Seminars Offered About PLATO," which describes the seminar series offered four times a year by the OCBI staff; "Information About OCBI," which displays tables and graphs on monthly terminal use, projected costs, and departmental involvement; and "Delaware PLATO System Hardware Configuration," which describes the computer system, communications equipment, and terminals. These four lessons are accessible from the demonstration index.

1:15 pm EDT
Wednesday, July 15, 1981
Welcome to the "wilde" PLATO System
Type your PLATO name, then press NEXT.
demo
PLATO is a trademark of Control Data Corporation.

Figure 6. Signing on for Lesson Review: The Name.

Type the name of your PLATO group. Then, while holding down the SHIFT key, press the STOP key.
When you are ready to leave, you should press these same keys (SHIFT-STOP) to "sign off".
> demo

Figure 7. Signing on for Lesson Review: The Group.

Demonstration of PLATO Lessons
Categories of Lessons
If you see a subject listed below that interests you, type that letter and you will be shown a list of lessons on that topic.
a - Special Features of the PLATO System
b - Lessons about the PLATO System
c - Agriculture and Biology Lessons
d - Art and Music Lessons
e - Chemistry, Engineering and Physics Lessons
f - Community and Career Education Lessons
g - Computer Science and Statistics Lessons
h - Economics, Accounting and Business Lessons
i - Education Lessons
j - English, Reading and Foreign Language Lessons
k - Home Economics Lessons
l - Math Lessons
m - Medical Science Lessons
n - Physical Education Lessons
o - Psychology and Social Science Lessons
p - Writing Comments and Questions about PLATO
q - Catalogs of PLATO Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
HELP is available
SHIFT-LAB for Personal Notes

Figure 8 (a). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Special Features of the PLATO System
a - Make a Monster
b - Animal Bagger
c - Make a Sentence
--uses the touch panel
d - Musimatic
e - Intervals Ear Training Game
--uses the music box
f - A Sample of Elementary Reading Lessons
--uses the audio device
g - Qualitative Organic Analysis
--an example of interactive dialogue
h - Demonstration of Microprocessor Graphics
--needs special PLATO terminal, such as an IST (any terminal with a black screen and white writing) or a Carroll (any terminal with wood sides)
i - Demonstration of a lesson using synthesized speech
--uses the Votrax
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (b). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Lessons about the PLATO System
a - How to Use PLATO
--This lesson is highly recommended if this is the first time you've ever used PLATO
b - Seminars Offered about PLATO
c - Information about the Delaware PLATO Project
d - The University of Delaware PLATO Network
e - PLATO IV - A Slightly Technical Introduction
f - Delaware PLATO System Hardware Configuration
g - Current policy for "udgaming"
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (c). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Agriculture and Biology Lessons
Agriculture and Biology
a - Locations of Endocrine Structures in Mammalian Species
b - Genetics Lab Simulation with Fruitflies
c - The Human Digestive System
d - Index of Agriculture and Biology Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (d). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Art and Music Lessons
Graphic Art and Design
a - SQUARE -- An Exercise in Design
b - Roses
c - Unit Design
d - Unit Design (version for programmable terminals)
e - An Index of Art and Graphics Lessons
Music Lessons
f - QUIDO Ear Training Lessons
--uses the music box
g - QUIDO -- Note Reading Drill and Game
h - Musimatic
i - Musical Terms for Student Conductors
j - Index of Music Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (e). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Chemistry, Engineering and Physics Lessons
Chemistry
a - Acid-Base Titration Experiment
b - Fractional Distillation
c - Index of Chemistry Lessons
Engineering
d - Kirchoff's Voltage and Current Laws
e - A Look at Integrated Circuit Technology
f - Aerospace Engineering Games
g - Expansion of an Ideal Gas
h - Catalog of Chemical Engineering Lessons
i - Catalog of Engineering Lessons
Physics
j - The Vector Olympics
k - Torque and Angular Momentum
l - Index of Physics Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (f). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Community and Career Education Lessons
Career Lessons
a - The Self Directed Search
b - Occupation Arrow
c - Index of Career Counseling Lessons
Community Education Lessons
d - Newark Community Resource Agencies
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (g). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Computer Science and Statistics Lessons
Computer Science
a - FORTRAN -- Introduction to DO Loops
b - BASIC -- An Introduction to BASIC
c - APL -- An Introduction to APL
d - Index of Computer Science Lessons
e - A compact BASIC compiler system
Statistics
f - Basic Statistical Package
g - Binomial Distribution
h - Catalog of Statistics Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (h). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Economics, Accounting and Business Lessons
Economics, Accounting and Business
a - The Personnel Game
b - Accounting: The Income Statement
c - Beginning Typing
d - Index of Business Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (i). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Education Lessons
Teacher Education
a - Simulation of the First Year of Teaching
b - Individual Reading Inventory Drill
Special Education
c - Finger Spelling
d - Catalog of Education Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (j). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
English, Reading and Foreign Language Lessons
English
a - Singulars, Plurals and Possessives
b - A Review of Grammar
c - Index of English Lessons
Reading
d - The Memory Game
e - Make a Sentence
f - The Race (A Story)
g - Index of Reading Lessons
Foreign Languages
h - Spanish--Spanish Culture
i - Russian--The Cyrillic Alphabet
j - French--La Geographie de la France
k - En oving i att bilda monster (Swedish Lesson)
l - Index of Language Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (k). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Home Economics Lessons
Home Economics
a - Metric Visualization Practice
b - Pattern Measurement
c - Index of Home Economics Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (l). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Math Lessons
Elementary Math
a - Darts (Number Line)
b - Speedway: Number Facts Game
c - Index of Elementary Math Lessons
Mathematics
d - Polar Coordinates
e - Equations with Fractions
f - Index of Mathematics Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (m). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Medical Science Lessons
Medicine
a - Poisons and Noxious Drugs
b - Emergency Patient Management Simulation
Nursing
c - Abdominal Perineal Resection: A Patient Care Simulation
d - Pediatric Pharmacology for Nurses
e - Care of Postoperative Patients
f - Index of Nursing Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (n). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Physical Education Lessons
Physical Education
a - Biomechanics and Sports
b - Speed and Repetitive Sports
c - Index of Physical Education Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (o). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Psychology and Social Science Lessons
Psychology
a - Short Term Memory
b - Anagrams
c - Index of Psychology Lessons
Social Sciences
d - Index of Population Dynamics Lessons
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (p). Index of Programs for Lesson Review.

Demonstration of PLATO Lessons
Writing Comments and Questions about PLATO
To write a comment or suggestion about the PLATO system, use this lesson:
a - Write a Comment about PLATO
To read some comments and suggestions commonly asked by visitors, use this lesson:
b - Visitors' Questions - - Some Answers
To report a technical problem with the PLATO terminal you are using, use this lesson:
c - Report a Problem with your Terminal
Choose a letter, or press one of these keys:
SHIFT-STOP to sign off
SHIFT-DATA for lesson names
HELP is available
SHIFT-BACK for the main index
SHIFT-LAB for Personal Notes

Figure 8 (q). Index of Programs for Lesson Review.

Figure 8 (r). Index of Programs for Lesson Review.

Participation in ADCIS

The University of Delaware is an active participant in the Association for the Development of Computer-Based Instructional Systems (ADCIS). ADCIS is the principal national forum for the scholarly exchange of ideas regarding computer-based education, and the OCBI regularly delivers progress reports at the Association's annual meetings. Papers have also been presented at ADCIS special interest group meetings for health sciences, implementation, PLATO, elementary-secondary schools, home economics, and music. Delaware faculty members organized the music interest group in 1976 and home economics in 1979, and this year they have organized two additional special interest groups for mathematics and for research, respectively.

A big event in the history of the OCBI was hosting the 1977 ADCIS National Convention at the Hotel DuPont, February 20-24, 1977. Jointly funded by the Delaware School Auxiliary Association, the Wemyss Foundation, ADCIS, and the University of Delaware, the convention attracted the largest attendance in its 10-year history. The participation of 32 vendors made the exhibit area a most comprehensive showing of computer-based educational technology. A special feature was the pre-session held for teachers on Monday, February 21, in cooperation with the State Department of Public Instruction. Entitled "Introduction to Educational Computing" the pre-session was attended by more than 300 Delaware teachers. During the main portion of the convention, several presentations were made by members of the PLATO staff and of the faculty. These are published in the 1977 ADCIS Proceedings.

At the 1978 ADCIS Convention which was held in Dallas, Texas from March 1 through March 4, 1978, all three members of the PLATO senior staff were elected officers. Bonnie Seiler was named Newsletter Editor for the PLATO Users Group, James Wilson was elected System Representative in the PLATO Users Group, and Fred Hofstetter was re-elected to a third consecutive term as President of the National Consortium for Computer-Based Music Instruction with an ex officio seat on the ADCIS Steering Committee. At the 1979 ADCIS Convention which was held in San Deigo, California, from February 26 through March 1, 1979, Bonnie Seiler was reappointed newsletter editor for the PLATO Users Group, James Wilson was reelected System Representative in the PLATO Users Group, and Fred Hofstetter was elected Conference Secretary and was also elected to serve on the Editorial Board of the Journal of Computer-Based Instruction.

During the 1980 Convention, held in Arlington, Virginia, the PLATO materials developed at the University were demonstrated at the Project's new demonstration booth, designed by Ray Nichols. John Silver hosted a PLATO User's Group session devoted to the computer hardware used by PLATO, including a demonstration of MicroPLATO terminals running courseware off-line.

At the 1981 Convention in Atlanta, Georgia, Dr. Ronald Wenger organized and was elected chairperson of a new special interest group for mathematics education (SIG/MATH). Gary Feurer, coordinator of CIRCLe, organized and was elected co-chairperson of the new special interest group for theory and research (SIG/TAR). Jessica Weissman was elected secretary of the PLATO Users Group. Michael Arenson once again served as chairperson for the pre-session. Bonnie Seiler presided over the Basic Design Tutorial, a hands-on workshop for 50 participants.

Several members of the OCBI staff and of the faculty have made formal presentations at ADCIS conventions. These are listed in Table 6.

Table 6

Presentations by Delaware Faculty and Staff
at National ADCIS Conventions

Name	Title of Presentation	Year
Michael A. Arenson	"The Development of a Competency-Based Education Program in Music Theory"	1979
David A. Barlow, A. Stuart Markham, Jr., and James G. Richards	"PLATO Facilitation of Precision Analysis in Biomechanics"	1979
Edward Boas, Jr.	"An Analysis of Instructional Delivery Systems in Vocational Education Comparing Computer-Managed Instruction, Teacher-Delivered Module"	1979
Morris Brooks	"University of Delaware Honors Program"	1980
John Brown	"Mathematics Applications of Computer Technology"	1977
Gerald R. Culley	"When PLATO Knows Latin: Benefits of Letting the Computer Inflect the Form"	1980
Angelo E. Di Antonio and Keith Slaughter	"Advanced Accounting"	1980
John Eisenberg	"Overview of the PLATO Modern Hebrew Project"	1977
Monica Fortner	"Important Criteria to Consider for Evaluating Instructional Simulation in Computer-Based Education"	1980
Nevin Frantz	"A Computer-Managed Instructional System for Vocational Technical Education"	1977
Roland Garton and John Silver	"Approaches to Converting PLATO Courseware to MicroTUTOR: A Case Study"	1981
Fred T. Hofstetter	"Computer-Based Recognition of Perceptual Patterns in Harmonic Dictation Exercises"	1978

Fred T. Hofstetter	"Controlled Evaluation of a Competency-Based Approach to Teaching Aural Internal Identification"	1979
Fred T. Hofstetter	"Program Design"	1980
Fred T. Hofstetter	"Cooperative PLATO Program Between the University of Delaware and the New Castle County School District Aimed at Eliminating Minority Group Isolation in New Castle County Schools"	1980
Fred T. Hofstetter	"Computer-Based Recognition of Perceptual Patterns in Chord Quality Dictation Exercises"	1980
Fred T. Hofstetter	"PLATO Projects at the University of Delaware"	1981
Fred T. Hofstetter	"Synopsis of the University of Delaware's Office of Computer-Based Instruction"	1981
Fred T. Hofstetter	"Computer-Based Recognition of Perceptual Patterns and Learning Styles in Rhythmic Dictation"	1981
Hank Hufnagel	"MENTOR -- A PLATO-like System of CAI"	1977
Rosemary Killam	"Data Retention and Analysis: Experience and Recommendations"	1977
Mark Laubach and James Hoffman	"Examination of a PLATO-Based Psychology Research Laboratory for Visual Perception"	1980
Frances Mayhew	"The Metric Practice Lesson"	1981
James Morrison	"Computer Applications in Business Education"	1977
James Morrison	"Innovative Classroom Applications of Computer Technology"	1979
James Morrison, Frances Mayhew and Mary Jo Kallal	"Strategies for Using Computer-Based Education with Home Economics Content"	1980
James Morrison	"Updating Project DISCO: A Distributive Information System in Consumer Economics"	1981

Raymond Nichols and James H. Wilson	"The Computer Display as a Medium in the Teaching of Aesthetics in Visual Design"	1977
Raymond Nichols	"The PLATO Display in the Teaching of Optical Letterspacing"	1979
Bonnie A. Seiler	"Computer Assistance in the Social Processes of Learning"	1977
Bonnie A. Seiler	"Planning a Lesson"	1980
Bonnie A. Seiler	"Uses and Abuses of Graphics in CBE Instruction"	1980
Bonnie A. Seiler	"Applying a Systematic Approach to CBE Development in an Academic Environment"	1981
Bonnie A. Seiler	"Lesson Structure"	1981
Richard Sharf	"A Computer-Based Career Guidance System"	1977
John Silver	"Microfiche, Random Access Slide Projectors and Alternatives for Displaying Visual Images"	1980
Robert Uffelman	"Computer-Assisted Testing at the Education Resource Building"	1978
Rita Wagstaff	"Media Selections: Alternative Delivery Systems"	1978
Jessica Weissman	"Learner Controlled Audio for Remedial Reading"	1980
Jessica Weissman	"Diagnosing and Teaching to Black English Vernacular Features"	1980
Ronald H. Wenger and Keith Slaughter	"Pre-Calculus Mathematics with PLATO Support"	1980
Charles Wickham and Raymond Nichols	"PLATO in the Teaching of Foundation Visual Design"	1979
James H. Wilson	"The Effects of Drill Structure on Learning in Phonetics Lessons"	1978

Peripheral Development

During 1979-1980 the OCBI added to its staff the position of peripheral design engineer. This position was created in order to allow the Office to solve some hardware problems related to research being done on the PLATO system and to facilitate the design of new equipment not currently available for the system. Some examples of how research problems have been solved and of how new equipment is being developed are provided for projects in psychology, physical education, music, and art.

Psychology needed a real-time clock accurate to 1/1000 second for measuring human response times to visual stimuli presented through microprocessor-programs in the PLATO terminal. In order to meet this need a timer was constructed out of MOS LSI integrated circuits. The design allows the researcher to make certain key connections which make the timer both versatile and easy to use.

Physical education needed a digitizer so that key points in films of human movements in competitive sports could be read by PLATO in making accurate stick figures which could in turn be used to analyze and to correct errors in sports movements. This need was fulfilled by purchasing a Bit Pad from Summagraphics Incorporated and interfacing it to the PLATO terminal in physical education's Biomechanics Laboratory.

A long-standing need of the music project has been a music synthesizer which could provide control over timbre, envelope, and special effects, in addition to control of time and frequency. In production beginning spring, 1981 is a new music synthesizer which contains fully programmable wave shapes and envelopes, plus control of glissando, tremolo, and vibrato. Based on a Z-80 microprocessor, the University of Delaware Sound Synthesizer (UDSS) can be used not only with the PLATO system but with any system which can send it 8-bit parallel data.

Additional work begun during the 1980-81 academic year included the design and construction of prototype interfaces to random-access Kodak slide projectors for use in physical education, psychology, and art, and to a pitch detector for teaching sight-singing in the music department. Support hardware for using ASCII terminals with the PLATO system has been constructed. Portions of a prototype system for optical input to the PLATO system have been acquired. Acceptable monitors for use in demonstrations and seminars have been identified. An interface for use of videodisc players with the PLATO terminal and one for microcomputers have been purchased.

Plans for 1981-82 include completion of projects begun to date and development of a musical keyboard input device. Further work will be done in the area of speech output, for general use as well as for research in education and in perception.

CHAPTER II. UNIVERSITY APPLICATIONS

This chapter contains a summary of activities in the departments using computer-based instruction at the University of Delaware. Sample lessons have been described with accompanying photographs in order to give the reader a general idea of the kinds of applications being pursued in the Office. Study of these descriptions gives not only an overview of the wide range of activities which are being supported, but it also provides a source of ideas from which new applications can arise.

Accounting

In the past year the Office of Computer-Based Instruction has provided 610 accounting students with a total of 2808 lesson hours. Usage of the PLATO system is gaining acceptance in the upper level accounting courses as advanced accounting students have averaged 18.6 hours.

Figure 9 shows a sample display from a lesson on cost accounting and the break-even point. This lesson provides a graph of the break-even equation and asks the student to choose a point on the graph. Then the student is asked whether that point will result in a profit or a loss. As this process is repeated, students are guided to fill in a chart which shows how much profit or loss is obtained from the various sales amounts.

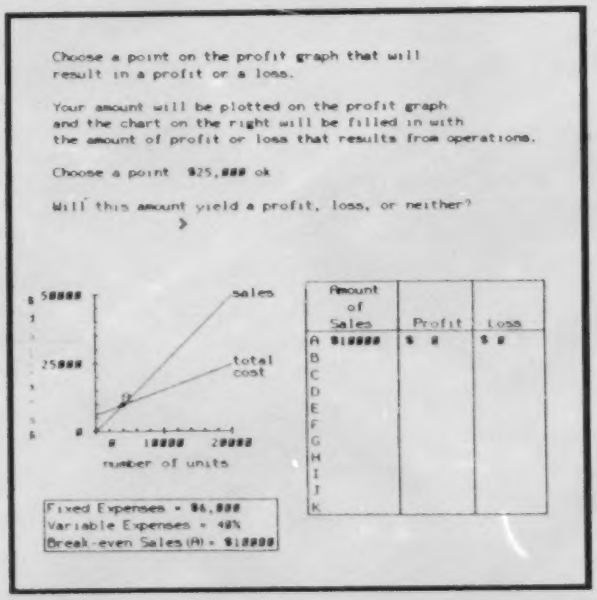


Figure 9. What is Break-Even Point? by Angelo Di Antonio and Louisa Bizoe. Copyright © 1979, 1980 by the University of Delaware.

Figure 10 shows the computation of the cost to manufacture one unit of product. The student is asked to compute the dollar values of the ending inventory of finished goods using absorption costing. Absorption costing along with direct costing are two types of cost accounting methods explained in this lesson.

Problem 6
Consider the following costs:
Direct materials $2 per unit
Direct labor $3 per unit
Variable overhead $4 per unit
Fixed overhead 10,000 or $5 per unit
Production 2000 units
Variable selling expense $1.5 per unit
Fixed selling expense $1,000
Sales 1,500 units

Figure 10. Costing Methods, by Jeffrey Gillespie and William Childs. Copyright © 1979 by the University of Delaware.

Agriculture

Faculty members from the Departments of Animal Science and Plant Science are using PLATO to provide students with simulated laboratory experiments and field experience which would be very costly to provide by other means. A number of the programs were originally developed by the College of Veterinary Medicine and by the Community College Biology Group at the University of Illinois. The successful implementation of these programs at the University of Delaware shows how through "courseware sharing" one institution can take advantage of PLATO programs written elsewhere.

In Animal Science, beginning students are using PLATO to study veterinary terminology, principles of digestion, muscular movement, mechanics of breathing, neuron structures and functions, spinal reflex loops, eye anatomy, and elementary psychophysiology of audition. Advanced undergraduates study mitotic cell division, probability and heredity, drosophilia genetics, natural selection, mitosis, gene mapping in diploid organisms, blood typing, population dynamics, pedigrees, karyotyping, and DNA, RNA, and protein synthesis. Graduate students concentrate on meiosis and the anatomy and physiology of reproduction.

In Plant Science, undergraduates can run PLATO programs in cellular structure and function, water relations, diffusion, osmosis, genetics, and the spectrophotometer. Graduate students study plant pathology, enzyme experiments, respiration, biogeochemical cycles, enzyme hormone interactions, photosynthesis, seed germination, apical dominance, flowering and photoperiod, fruiting and leaf senescence, gas chromatography, and gene mapping in diploid organisms.

One kind of experience that agriculture students obtain from PLATO is illustrated in the following example. Figure 11 shows a sample display from the neuron structure and

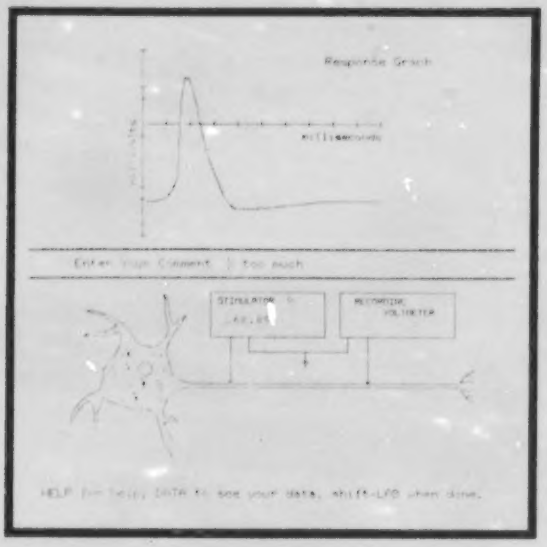


Figure 11. Neuron Structure and Function, by S. H. Boggs. Copyright © 1976 by the Board of Trustees of the University of Illinois.

function program. PLATO simulates neurons with various internal structures. The student stimulates the neurons by pressing keys at the terminal and observes the effects of the stimulations as read by a recording voltmeter. The student can experiment with different rates and patterns of stimulation. PLATO keeps track of what the student does and provides the student with reports in the form of response graphs.

Since 1977 the College of Agriculture has been developing a series of PLATO lessons dealing with the endocrine system. Five lessons of this series have been completed to date covering the following topics:

1. Terminology and Definitions
2. Listing and Classification of Endocrine Structures
3. Location of Endocrine Structures in Mammalian Species
4. Location of Endocrine Structures in Avian Species
5. Hormones Secreted by Endocrine Structures

After teaching terminology, definitions, and classifications of endocrine structures in the first two lessons, PLATO presents the students with an outline of the human body in the third lesson and asks the students what endocrine structures they would like to see. Figure 12 shows how one student has asked to see the kidneys, and PLATO has responded by drawing the kidneys in the proper locations. Later on in the lesson, the body outline is drawn again with all of the structures drawn in their proper locations, and the student is required to correctly identify each structure. Figure 13 shows how this way of teaching locations of endocrine structures was expanded to include avian species in the fourth lesson.

Figure 12. Endocrine System, by Paul Sammelwitz and Daniel Tripp. Copyright © 1978 by the University of Delaware.

Figure 13. Endocrine System, by Paul Sammelwitz and Daniel Tripp. Copyright © 1978, 1979 by the University of Delaware.

The College is also using PLATO Learning Management to make available practice tests to beginning animal and plant science students. These tests present questions to students, record and grade their responses, analyze their errors, and suggest learning activities to improve their scores on future practice tests which they may repeat as often as they wish.

The Department of Agricultural Economics is developing a program where students learn basic managerial skills through the use of an agribusiness simulation. This lesson contains actual data obtained from Southern States Cooperative, an agricultural business supply store. Students in agricultural marketing and management courses gain experience in solving typical problems faced by a manager in the areas of personnel, advertising, inventory and merchandising. Figure 14 shows a typical question and options that the student is given.

KEY INDICATORS

Key Areas	PERIOD 1		YEAR TO DATE	
	CUR YR	LAST YR	CUR YR	LAST YR
Margins & Service Income to Volume	15.3	18.5	15.3	18.5
Salaries & Wages to Volume	7.8	8.7	7.8	8.7
Expense to Volume	23.3	24.8	23.3	24.8
Net Savings to Volume	6.5*	6.6*	6.5*	6.6*
Volume Increase	22.3	6.3	22.3	6.3

* denotes red figure

Problem of the month:

Through your operational supervisor, the regional manager has informed you that maximum 8 percent merit raises are available for full-time personnel in your store.

Pick a letter:)

OPTIONS

a. Resolve the problem
b. Review financial inventory management
c. Discuss problem with operational supervisor

Figure 14. An Agribusiness Management Simulation, by Michael Hudson, Ulrich Toensmeyer, and Carol Leefeldt. Copyright © 1980-81 by the University of Delaware.

Anthropology

The Department of Anthropology has developed tutorial and drill lessons for use with its introductory courses in biological and socio-cultural anthropology.

An evolutionary perspective is important in the field of biological anthropology, which is the study of the biological aspects of man's culture. PLATO lessons which emphasize this perspective have been written about cellular structure and the genetic laws of inheritance.

Socio-cultural anthropologists are interested in the interrelationships among the many aspects of the cultures of the peoples they study. For instance, particular rules and obligations are associated with a group of people whose members live near one another or are related by blood. Examples of such rules include restrictions on permissible marriage partners and the manner in which two individuals address and communicate with one another. Socio-cultural anthropologists interested in studying the rules operating within a particular population group might include in an initial study the residence and descent patterns characteristic of the group.

Figure 15 shows a display from a lesson on anthropological residence theory in which a student has chosen a particular individual on a genealogical chart and then identified every member of the matrilocal residence group to which that individual belongs. The student learns that matrilocal residence groups exist in a population where unmarried children live with their parents, and married couples settle with or near the wife's parents.

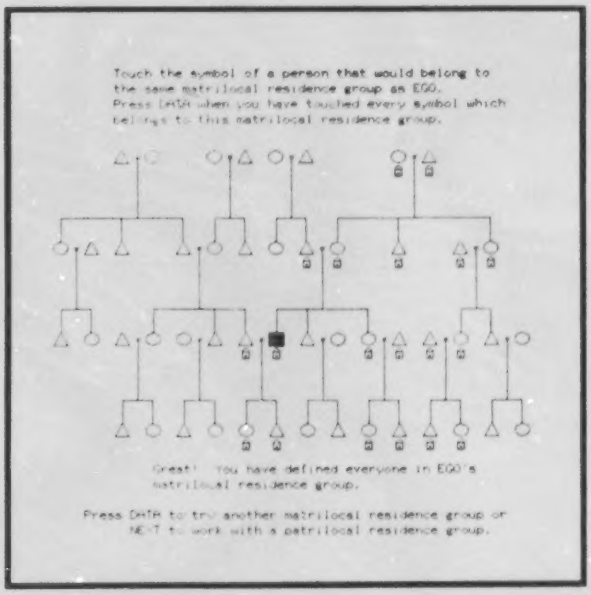

Touch the symbol of a person that would belong to
the same matrilocal residence group as EGO.
Press ENTER when you have touched every symbol which
belongs to this matrilocal residence group.
Great! You have defined everyone in EGO's
matrilocal residence group.
Press ENTER to try another matrilocal residence group or
NEXT to work with a patrilocal residence group.

Figure 15. Anthropological Residence Theory, by Norman Schwartz, Monica Fortner, and Charles Collings. Copyright © 1978, 1979 by the University of Delaware.

In a lesson on anthropological descent theory, the student must similarly identify descent relationships for a given individual in a population group. Later in the lesson, the student is presented with an ethnographic description, and asked to identify the descent rule which applies to the population group described. As depicted in Figure 16, a student has correctly identified the patrilineal descent rule which applies to a population group called the Dobrinders. The underlining in the text indicates to the student the portion of the description which should have made clear the descent rule which applies.

Dr. Peter Roe, Assistant Professor, Department of Anthropology, was awarded a Local Course Improvement grant by the National Science Foundation for the term June, 1980, through August, 1982. The grant calls for the PLATO system to be used in introductory and advanced anthropology courses to show how artistic style can be understood as a process, both as a formal system of visual logic and as a vehicle to convey symbolic information about the culture which produces it. Two lessons are being developed and evaluated, one which introduces the concepts of aesthetic syntactics and gives examples of their application, and a second which requires students to utilize these concepts to create designs according to a specified set of rules. The first lesson illustrates the principle of Rule Replication Behavior on a graphic display. Figure 17 shows how students are asked to replicate a particular vessel by touching component parts reproduced on the screen, starting, as would a potter, with the base. In illustrating Rule Creation Behavior, students are asked to touch on a similar display any parts which they wish to use in creating their own unique pots.

Figure 16. Anthropological Descent Theory, by Norman Schwartz, Monica Fortner, and Charles Collings. Copyright © 1978, 1979 by the University of Delaware.

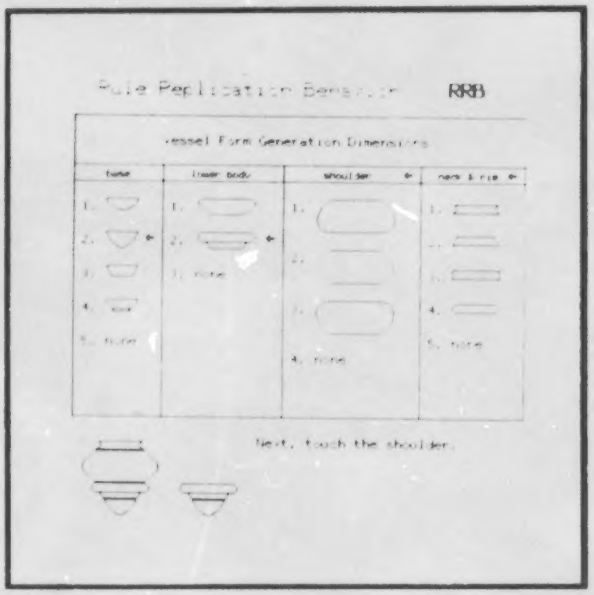


Figure 17. The Anthropological Study of Art Style, by Peter Roe and Karen Sims. Copyright © 1980 by the University of Delaware.

Art

The Department of Art is developing its own package of PLATO programs for the purpose of improving instruction in basic design and graphic design, including courses in typography, basic illustration, advertising design, and portfolio preparation. Using the highly sophisticated graphics features of PLATO, students are interactively able to create and to alter designs on the terminal screen. Work which used to take fifteen hours to complete on paper can be done in three hours on PLATO, thereby giving students the opportunity to work many more problems than they could before. They are also developing a better aesthetic judgment, because the lesson makes it so easy for them to alter their designs. If they don't like part of a design, they have the capability to change that part while retaining the remainder of the design. Thus students are encouraged to make what they like rather than like what they make.

The main applications of PLATO in art can best be explained by looking at how students use three programs, namely, "unit design," "grey scale practice in tonal recognition," "optical letter spacing," and "logo design." In the unit design program, the student enters a shape into the computer by either turning on or turning off dots on a 96 x 96 dot matrix. Figure 18 shows how the student creates the image by selecting options like "move," "delete point," "store," and "draw line." Next, the student uses the basic shape to form a composite image by performing graphic transformations of the basic shape. Figure 19 shows how the student creates the composite image by rotating, mirroring, and inverting the positive/negative relationships of each element.

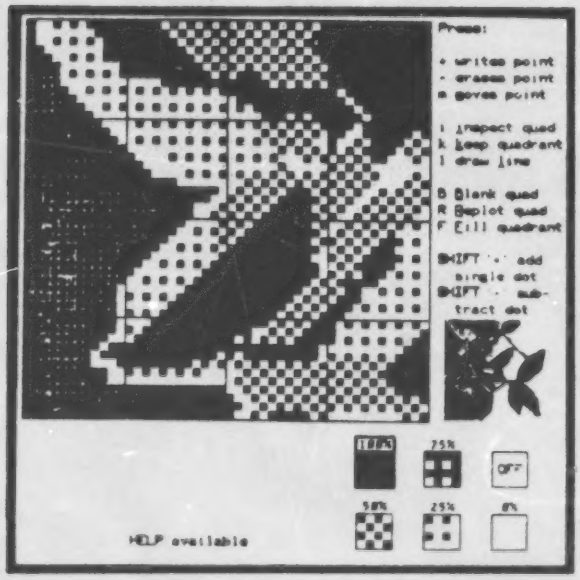


Figure 18. Unit Design: Creating the Basic Image, by Raymond Nichols. Copyright © 1977 by the University of Delaware.

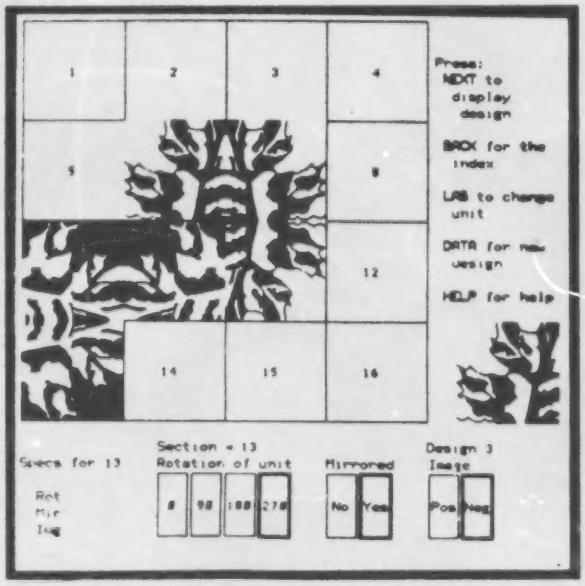


Figure 19. Unit Design: Creating the Composite, by Raymond Nichols. Copyright © 1977 by the University of Delaware.

Through successive tries at designing basic shapes and performing graphic transformations, the student learns how to create clever and intricate designs such as the one shown in Figure 20.

The grey scale program gives art students practice in recognizing the tonal values of the many shades of grey. This lesson presents the students with a grid of 20 x 30 squares. The student can then see the shade of grey for each square by telling PLATO the percentage of grey which should be in the square. Some students have become so adept at recognizing values of grey on PLATO that they can use the grey scale program to create facial images, such as the one shown in Figure 21.

Since typography plays such an important role in advertising, it is extremely important for the art student to be able to space letters so that the printed word is both aesthetically pleasing and readable. The letter spacing program gives the students interactive practice in spacing letters without requiring them to go through the time-consuming process of drawing and inking a word every time they want to change the placement of a letter. Using PLATO, students can do many more assignments than were possible before, and the instructor is able to offer greater help to the students because he gets to see much more of their work. Students can work with words containing up to nine letters from each of five typefaces: Helvetica, Baskerville,

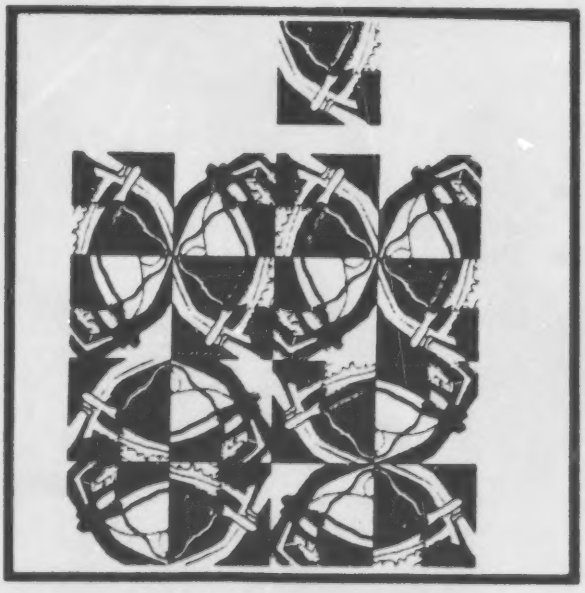


Figure 20. Unit Design: the Finished Product, by Raymond Nichols. Copyright © 1977 by the University of Delaware.

Figure 21. Grey Scale, by Raymond Nichols. Copyright © 1977 by the University of Delaware.

Garamond, Century Expanded, and Bodoni. Figure 22 shows a sample display from the letter spacing program. In this display the student is just about to move the "E" further over to the left.

Another typography lesson under development teaches the techniques involved in producing printed materials such as brochures, magazine pages, and advertisements. The students must prepare mechanical drawings of the subject matter. This provides them with practice in using a haberule to measure type size and spacing, and adding printer's marks to the copy using the correct color markings. They proceed through the preparation steps and the processing and development stages to the final procedures necessary in actually printing the material. This lesson also provides the student an opportunity to practice these techniques more often, thereby reducing the chance of error on actual mechanicals they create.

"Logodesign" was written to provide the graphic design student with a format for the development of designs which would be used for trademarks and corporate identity work. Figure 23 shows the basic drawing for such a design. The lesson allows the student to draw lines and circles in any configuration, setting the borders for a series of shapes which will eventually form the final design. After finishing the drawing, any of the shapes which are bordered by a line or a circle may be filled in. By indicating the desired areas to be filled, the program will then execute the finished

Pick the number of the letter you'd like to move:
Current letter being moved: 2
FINEST
1 2 3 4
Press:
'a' to move arrows to the left, 'd' to move arrow to the right
'A' for coarse positioning, 'a' for fine positioning,
's' to display top arrows
NEXT to display the letter in its new position,
SHIFT-NEXT to move letters right of selected letter,
BACK to select a new word,
SHIFT-BACK to select another typeface.

Figure 22. Letter Spacing, by Raymond Nichols. Copyright © 1977 by the University of Delaware.

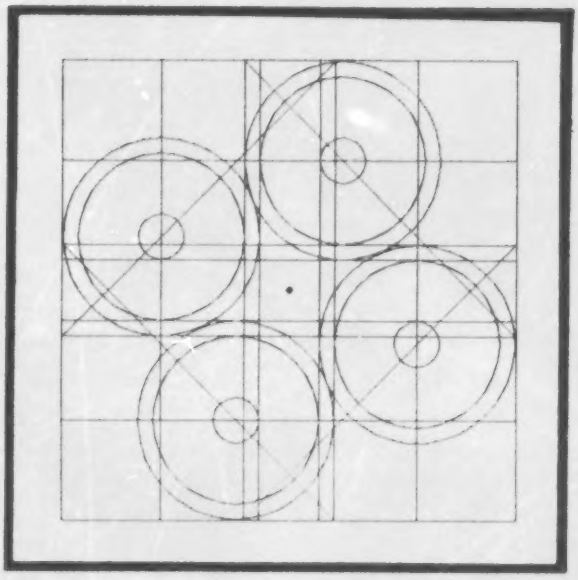


Figure 23. Logodesign: Creating the Basic Design, by Raymond Nichols. Copyright © 1979 by the University of Delaware.

design. Figure 24 shows the finished design superimposed over the original drawing. The small dots spread over the drawing are the indicators that those specific shapes have been chosen for filling.

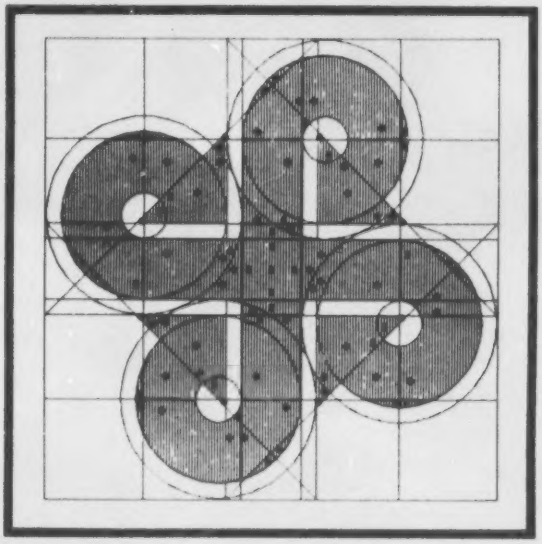


Figure 24. Logodesign: the Finished Design, by Raymond Nichols. Copyright © 1979 by the University of Delaware.

Biology

The School of Life and Health Sciences is using PLATO to supplement laboratory exercises in genetics. Many traditionally taught genetics exercises require that students learn time-consuming and mechanically difficult procedures. In an actual laboratory situation, students often overlook the important concepts under study in their efforts to complete complicated manual procedures within the time allotted. The flexible, interactive nature of the PLATO genetics lessons permits students to design experiments, obtain data, graph and analyze results, and draw conclusions without having to first master expensive and time-consuming procedures which do not contribute to their understanding of the concepts. Using a PLATO lesson as a tool, students unskilled in laboratory procedures can learn much more from complex and information-rich experimental designs. Through simulation, they can obtain data from sources normally unavailable to beginning students.

Professor David Sheppard is developing a complete genetics curriculum funded by a Local Course Improvement grant from the National Science Foundation. Three large lessons were completed this year, namely, "Somatic Cell Genetics," "The Molecular Nature of the LAC Operon," and "Positioning Genes in Bacteria by Deletion Mapping." Six new lessons are under development, including "Recombinant DNA Formation," "Molecular Basis of Mutagenesis," "The Tryptophan Operon," "Population Genetics - Genetic Drift," "Population Genetics - Natural Selection," and "The Use of Genetic Mosaics in the Analysis of Development."

Figure 25 shows a display from the lesson "Somatic Cell Genetics." In a simulated experiment, students learn the current techniques used to locate genes on chromosomes. The student must isolate cells which exhibit an abnormal trait, then determine which genes govern this trait and on which chromosome they are located. First, the student simulates the growth of cells on various culture media. Then, by correlating the absence or presence of the trait with the presence of a certain chromosome, the student can eventually pinpoint the exact location of the controlling gene.

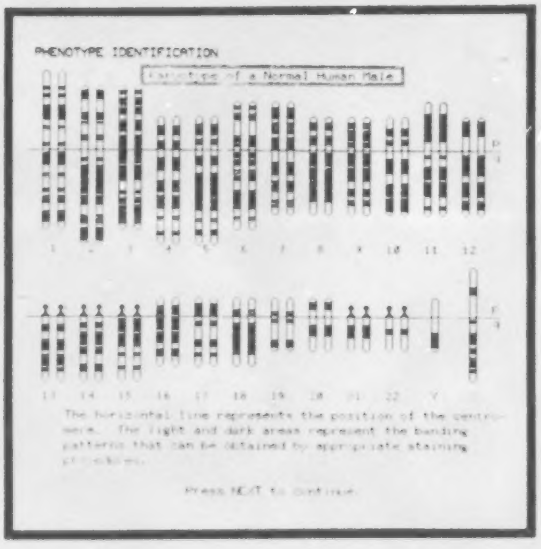


Figure 25. Somatic Cell Genetics, by David E. Sheppard and John C. Beyer. Copyright © 1980 by the University of Delaware.

Figure 26 shows a genetic map from the deletion mapping lesson. Students are presented with a matrix of deletion mutation crosses and are asked to determine which deletion mutations overlap and what are the relative orders of the deletions on the genetic map. With the aid of interactive instructions, students are able to complete a difficult laboratory exercise much more easily than in a conventional laboratory situation. Upon completion of the exercise, student work is evaluated immediately. Students receive informative feedback to point out incorrect positioning, and they are asked to make changes to obtain a correct mapping.

In another Genetics lesson, the entire mitotic divisional process from parent cell through to two daughter cells unfolds in a lively animation. Each step is thoroughly explained, and the students must answer questions pertaining to each display. A quiz on all the phases of mitosis completes the lesson. Prophase is the longest phase of all the cellular division steps in the mitotic process. Early and late Prophase are shown in Figure 27.

MAPPING DELETION MUTATIONS
You should be able to determine, using the matrix of deletion mutation crosses, not only which deletion mutations overlap, but also the relative order of the deletions on the genetic map shown above.
Press NEXT to continue.
Deletion Mutants:
Deletion Mutants:

Figure 26. Positioning Genes in Bacteria by Deletion Mapping, by David E. Sheppard and John C. Beyer. Copyright © 1980 by the University of Delaware.

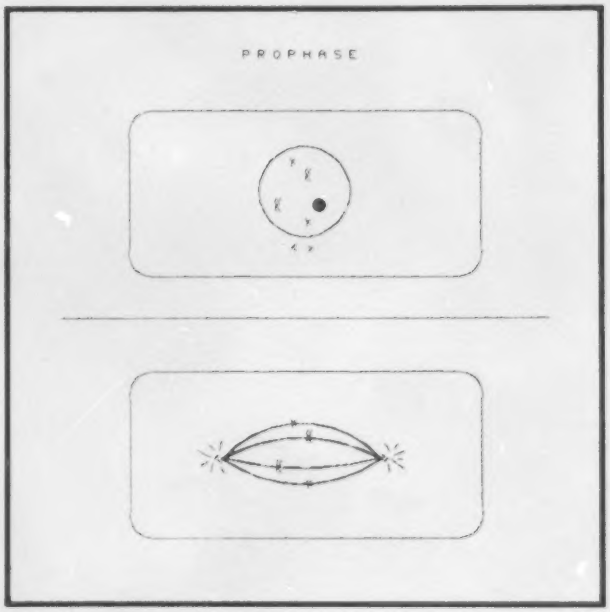


Figure 27. Mitosis and Cell Division, by John C. Beyer. Copyright © 1980 by the University of Delaware.

Chemical Engineering

An important aspect in engineering education is the development of problem-solving skills. Since large numbers of students are now choosing to major in chemical engineering, and since engineering students are avid computer users, the chemical engineering department has chosen to develop PLATO lessons to provide additional problem-solving experiences and tutoring to its students. This work is being supported by a two-year grant awarded by the National Science Foundation to Professor Stanley Sandler.

Of the fifteen lessons that have been brought to the final stages of testing, review, and student use, thirteen are intended for the two-semester upper-level course sequence in chemical engineering thermodynamics. The other two were written for freshman and sophomore courses. Figure 28 is part of a lesson which instructs the students on the use of an Othmer still to get vapor-liquid equilibrium data and then tests their abilities to analyze the data and to extract activity coefficients to determine if the data are thermodynamically consistent, and to compare the activity coefficients with various theoretical models.

Figure 29 shows a sample display from a lesson on the Rankine Refrigeration Cycle, which instructs and tests undergraduate chemical engineering students on their understanding of thermodynamic cycles and the reading of thermodynamic diagrams. Following an idealized Rankine refrigeration cycle on a pressure-enthalpy diagram, students learn how to calculate the coefficient of performance.

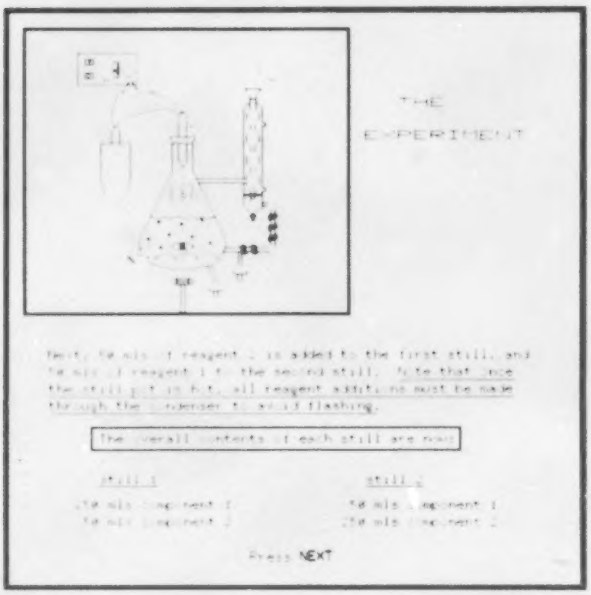


Figure 28. Modeling of Binary Mixtures, by Stanley Sandler and Douglas Harrell. Copyright © 1978 by the University of Delaware.

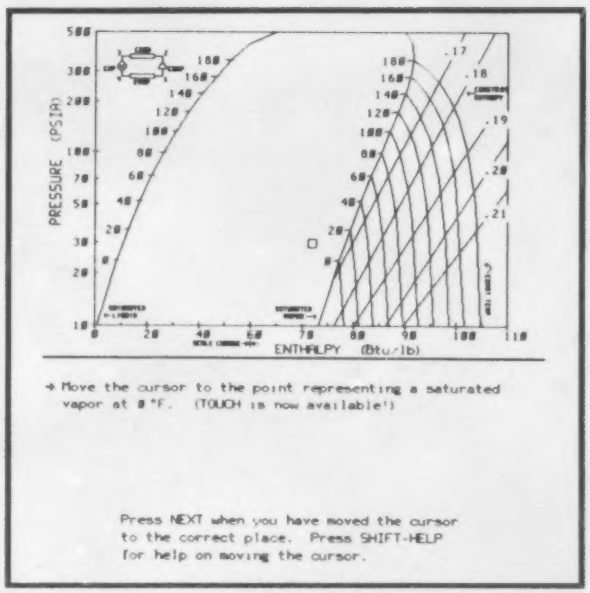

PRESSURE (PSIA)
ENTHALPY (Btu/lb)
→ Move the cursor to the point representing a saturated vapor at 0 °F. (TOUCH is now available!)
Press NEXT when you have moved the cursor to the correct place. Press SHIFT-HELP for help on moving the cursor.

Figure 29. The Rankine Refrigeration Cycle, by Stanley Sandler, Robert Lamb, and Andrew Semprebon. Copyright © 1980 by the University of Delaware.

Chemistry

In response to the growing number of chemistry students using PLATO lessons, three PLATO terminals have been added to the seventeen terminals at the chemistry PLATO site, bringing the total to twenty. This allows easier access of terminals to students, professors, and chemistry lesson developers.

Taking advantage of the large package of chemistry lessons written under NSF funding at the University of Illinois, the Department of Chemistry has enjoyed much success helping students learn and reinforce a good basic knowledge of the principles of chemistry. Students can see simulations of chemical reactions in three dimensions. Drill-and-practice lessons offer students the opportunity to review sections and problems as much as is needed for firm comprehension. Diagnostic lessons help check achievement levels and progress. By using the computer to simulate chemical reactions, students get to work with many more samples than is possible in the traditional chemistry lab. In problem-solving, students have the freedom to experiment with many methods of finding a solution.

Figure 30 shows how students are checked on their knowledge of the energy levels of electron shells in a lesson on the Aufbau Principle. Each orbital is represented by a circle in order of increasing energy, and when each one is touched, a symbol representing an electron with spin direction is placed in it. The student must place the correct number of electrons in each orbital before getting credit for that element, proceeding to the next section in the lesson after eight elements have been correctly displayed.

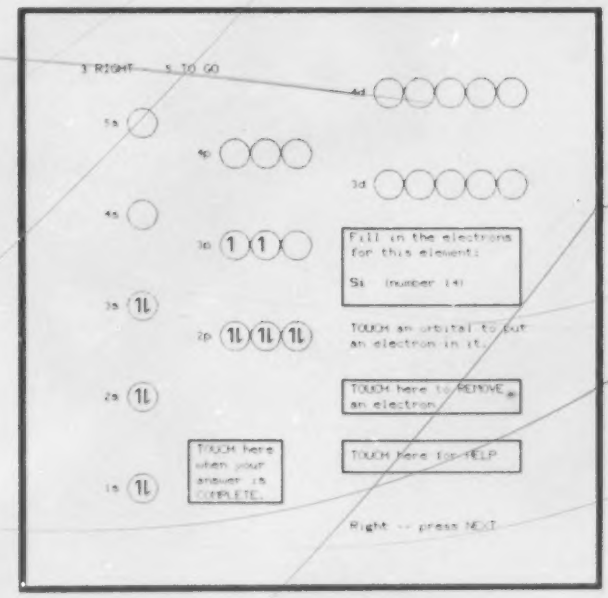


Figure 30. Electronic Structure of Atoms, by Ruth Chabay. Copyright © 1976 by the Board of Trustees of the University of Illinois.

Figure 31 shows how the PLATO system teaches the standardization of an aqueous NaOH solution by simulating acid-base titrations. The student must perform every step in the simulation from filling the buret to observing the change of color at the end of the experiment. The lesson makes sure that the student follows correct laboratory procedures, helping out with suggestions when necessary.

Lessons are being developed at the University of Delaware to fill instructional needs in chemistry. Figure 32 shows a chart which the student builds while learning the meaning of the pH factor and how logarithms are used in determing pH. In another new

ACID-BASE TITRATIONS
Standardization of an aqueous NaOH solution.
In this experiment you are to determine the concentration of a NaOH solution by titration of potassium acid phthalate (MW = 204).
The base is about 0.1 M.
What do you want to do first?
) fill the buret
Plato is filling the buret for you.
Press s to stop filling.
Press f to restart filling.
Fill the buret almost to the top.
For help press HELP. To use a calculator press DATA

Figure 31. Acid-Base Titrations, by Stanley Smith. Copyright © 1976 by the Board of Trustees of the University of Illinois.

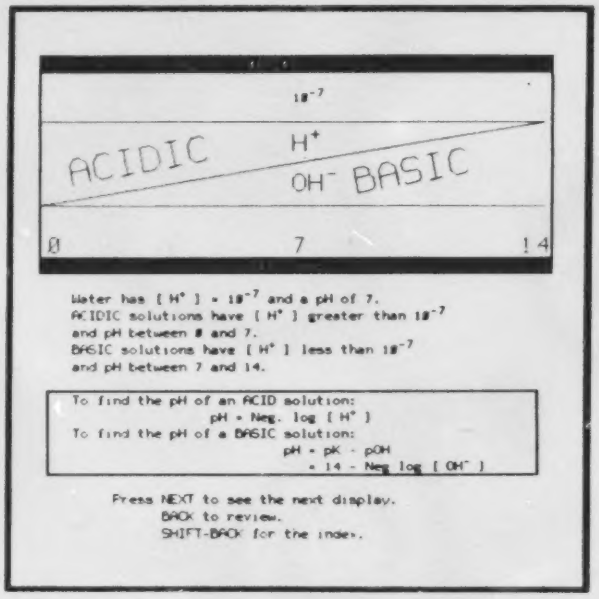

10^{-7}
ACIDIC
H^+
OH^- BASIC
0
7
14
Water has [H^+] = 10^{-7} and a pH of 7.
ACIDIC solutions have [H^+] greater than 10^{-7} and pH between 0 and 7.
BASIC solutions have [H^+] less than 10^{-7} and pH between 7 and 14.
To find the pH of an ACID solution:
pH = Neg. log [H^+]
To find the pH of a BASIC solution:
pH = pK - pOH
= 14 - Neg log [OH^-]
Press NEXT to see the next display.
BACK to review.
SHIFT-BACK for the index.

Figure 32. Application of Logs: pH, by Bernard Russiello. Copyright © 1980 by the University of Delaware.

lesson, high-resolution graphics help convey the concept of the spatial arrangement of molecules as shown in Figure 33. The molecule in the picture is composed of a central atom, A, and eight surrounding atoms, X. The picture shows how the surrounding atoms arrange themselves as far apart as possible on the surface of an imaginary sphere with the central atom as the center. In Figure 34, the sphere is removed and the octahedral framework of this molecule is drawn in dotted lines.

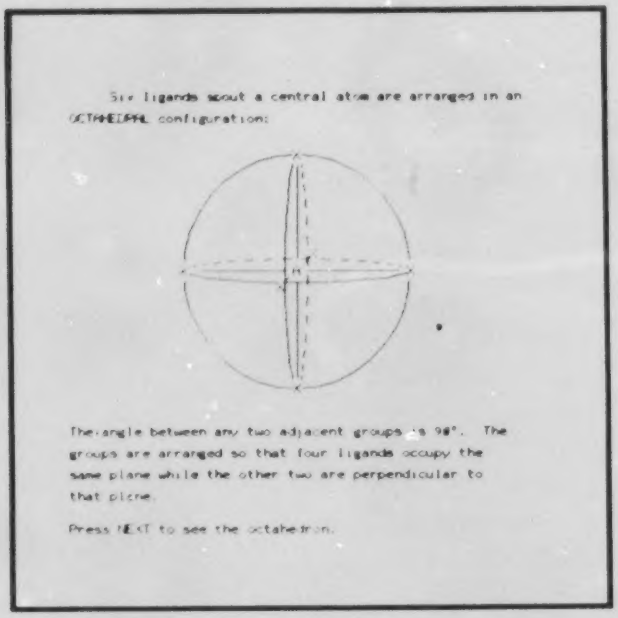

Six ligands about a central atom are arranged in an
OCTAHEDRAL configuration:
The angle between any two adjacent groups is 90°. The
groups are arranged so that four ligands occupy the
same plane while the other two are perpendicular to
that plane.
Press NEXT to see the octahedron.

Figure 33. Determining Shapes of Molecules: VSEPR, by Edward Davis, Mary Jane Fagan, Roland Garton, and Leonid Vishnevetsky. Copyright 1980 by the University of Delaware.

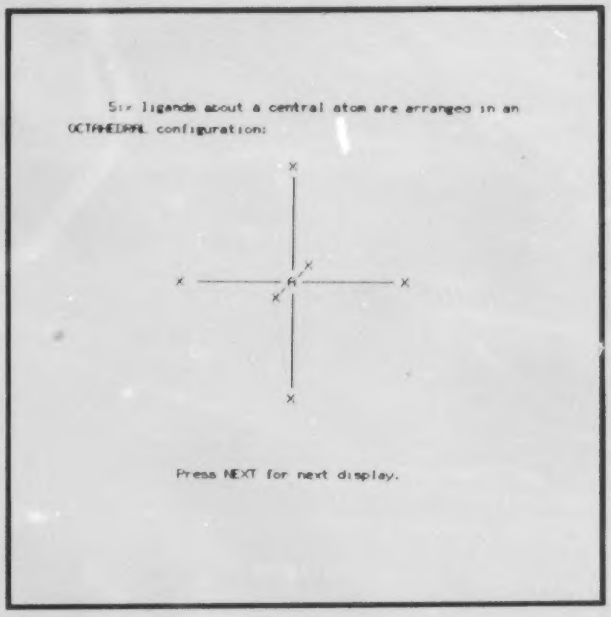


Figure 34. Determining Shapes of Molecules: VSEPR, by Edward Davis, Mary Jane Fagan, Roland Garton, and Leonid Vishnevetsky. Copyright 1980 by the University of Delaware.

Civil Engineering

The faculty is investigating the value of PLATO as a tool in teaching topics in civil engineering. A lesson has been developed for use in Statics and Structural Analysis courses, covering the topics of axial force, shear and moment. This lesson teaches students the concepts of internal force, definitions and methods of calculating internal axial force, shear and moment, and it provides practice in calculating these forces.

Figure 35 shows a part of the lesson which explains the concept of internal force. Here the student is shown a rod which is used to suspend a clock from a ceiling. It is explained that internal forces inside the rod hold it together and enable it to support the weight of the clock.

In Figure 36 the student has just completed a section which explains the method of calculating axial force, shear and moment, and is now being asked to use this method to calculate these internal forces at point B. If the student answers correctly, he continues on to the next part of the lesson. If not, the student is given helpful hints, depending on the nature of his error, and then he must try again.

Figure 35. Internal Force, by Eugene Chesson and Jeffrey Snyder. Copyright © 1979, 1980 by the University of Delaware.

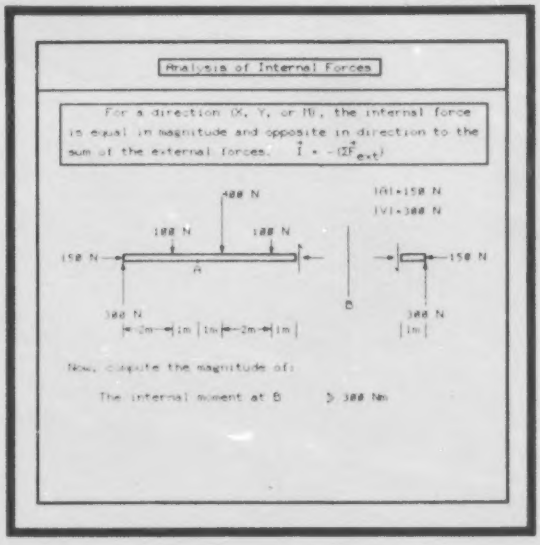

Analysis of Internal Forces
For a direction (X, Y, or M), the internal force is equal in magnitude and opposite in direction to the sum of the external forces.
400 N
150 N
300 N
A
B
Now, compute the magnitude of:
The internal moment at B

Figure 36. Internal Force, by Eugene Chesson and Jeffrey Snyder. Copyright © 1979, 1980 by the University of Delaware.

Figure 37 is from a tutorial section where the lesson teaches the student how to solve more complicated problems using the method of summation. The student is being shown how to make a load diagram for a beam which is being acted on by various loads. The student has already been shown how to do the calculations at two points along the beam, and now the student is being asked to calculate the load at other points. Helpful hints are given if the student encounters difficulty.

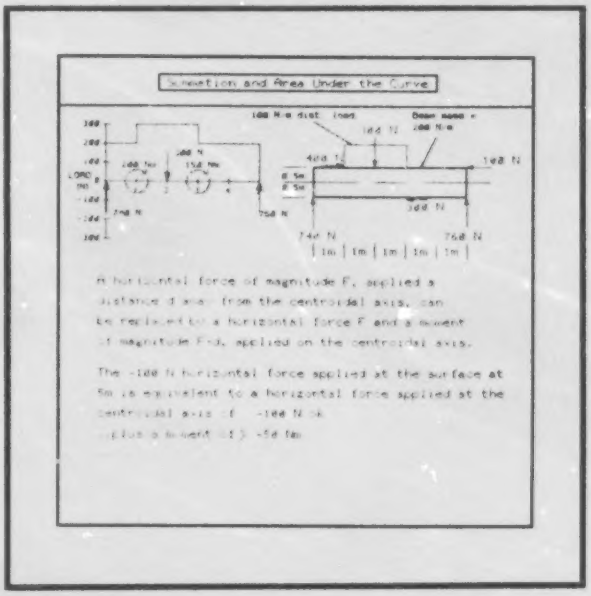

Interaction and Area Under the Curve
A horizontal force of magnitude F, applied a
distance d away from the centroidal axis, can
be replaced by a horizontal force F and a moment
of magnitude F·d, applied on the centroidal axis.
The -100 N horizontal force applied at the surface at
5m is equivalent to a horizontal force applied at the
centroidal axis of -100 N
plus a moment of -50 Nm

Figure 37. Internal Force, by Eugene Chesson and Jeffrey Snyder. Copyright © 1979, 1980 by the University of Delaware.

Computer Science

The computer and information sciences department and the computing center instructional services department have begun developing instructional materials on the PLATO system for use in teaching new users about various computers and software packages available through the computing center. A typical lesson will last thirty minutes and will cover basic material such as how a particular editor or operating system can be used to create and execute files. These lessons will be used heavily by introductory computer science and engineering classes.

Existing lessons on the PLATO system range from advanced topics, such as systems programming, numerical analysis, and information processing, to introductory lessons that teach what a computer is, basic computer terminology, and programming languages. Shown below are two lessons that teach FORTRAN programming. In Figure 38, the students are given an "old program," and they are asked to retype it as a "new program" by compressing the if-statements together using Boolean constructs. So far, the student has written the third and fourth lines of the old program as one statement in the third line of the new program, and is in the process of making the fifth, sixth, and seventh lines of the old program the fourth line of the new program.

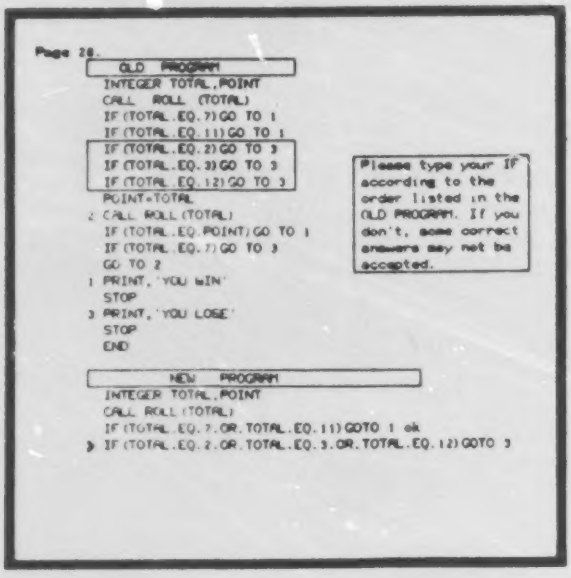

Page 28.
OLD PROGRAM
INTEGER TOTAL,POINT
CALL ROLL (TOTAL)
IF (TOTAL.EQ.7) GO TO 1
IF (TOTAL.EQ.11) GO TO 1
IF (TOTAL.EQ.2) GO TO 3
IF (TOTAL.EQ.3) GO TO 3
IF (TOTAL.EQ.12) GO TO 3
POINT=TOTAL
2 CALL ROLL (TOTAL)
IF (TOTAL.EQ.POINT) GO TO 1
IF (TOTAL.EQ.7) GO TO 3
GO TO 2
1 PRINT,'YOU WIN'
STOP
3 PRINT,'YOU LOSE'
STOP
END
Please type your IF according to the order listed in the OLD PROGRAM. If you don't, some correct answers may not be accepted.
NEW PROGRAM
INTEGER TOTAL,POINT
CALL ROLL (TOTAL)
IF (TOTAL.EQ.7.OR.TOTAL.EQ.11) GOTO 1 ok
IF (TOTAL.EQ.2.OR.TOTAL.EQ.3.OR.TOTAL.EQ.12) GOTO 3

Figure 38. Experience with FORTRAN FORMAT Statements, by Richard Simkin and H. C. Friedman. Copyright © 1977 by the Board of Trustees of the University of Illinois.

Figure 39 shows how the PLATO system can simulate a FORTRAN compiler and help the students understand what the various statements do by allowing them to change their parameters and then observe their execution. In this example, the students are allowed to use four formating statements and two program execution statements. The students can edit the statements, enter data cards, initialize variables, and execute the program to find out the effects of their changes.

Previously developed at the University of Delaware are lessons which use simulation techniques in order to allow the students to design a machine and then simulate the execution of the machine. Two mathematical models were previously implemented: Turing Machines and Push-Down Automata. Figure 40 shows how a student enters the states, tape symbols, and state transitions for a Turing machine. After the state transition table has been completed, the student can see the execution of the Turing machine occur in real time on the PLATO screen, and the student can step through the process one statement at a time, or the student can see the entire execution carried out

6.99 43.8
READ 1, A, B
PRINT 3, I
What do you want to do? 1,2) Last READ or PRINT statement
3) Enter a statement 4) Enter data cards 5) Start new variables
1 FORMAT(F10.4,F4.2)
2 FORMAT(I10,I5)
3 FORMAT('0',' THIS IS AN INTEGER ',I10)
4 FORMAT('0',' THIS IS A REAL ',F12.4)
A = 6.99 J = -14
B = 43.8
I = 7
THIS IS AN INTEGER -14

Figure 39. Understanding the FORTRAN IF Statement, by Gregory Strass. Copyright © 1975 by the Board of Trustees of the University of Illinois.

Entering Turing Machine: example machine
1. The states of the turing machine
2. The tape symbols of the turing machine
3. The state transitions
Press SHIFT-DATA for assignments
Press HELP for help on entering tm
1, 2, or 3 to change that section
SHIFT-HELP to start all over again
LAB to execute the turing machine

Figure 40. A Turing Machine Simulator, by Ralph Weischedel and Joseph P. Maia. Copyright © 1979 by the University of Delaware.

automatically. Figure 41 shows what the display looks like when the execution of the table in Figure 40 is halted. There are "instructor options" lessons associated with these simulators. They allow the instructor to enter assignments, inspect student work, and grade completed assignments by entering "test input strings" and executing the students' machines.

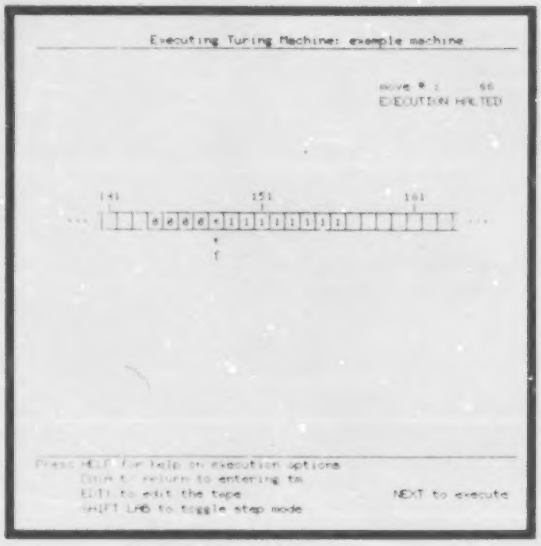


Figure 41. A Turing Machine Simulator, by Ralph Weischedel and Joseph P. Maia. Copyright © 1979 by the University of Delaware.

Continuing Education

In the 1980-81 academic year the Division of Continuing Education began offering courses comprised of lessons from Control Data's published courseware libraries and lessons developed here at the University. Five courses were offered with a total enrollment of thirty-eight students.

The Division of Continuing Education and the Office of Computer-Based Instruction are working to expand the number of courses which can be offered using a predominantly computer-based delivery system. This format is especially appropriate for continuing education students since sessions on the PLATO system can be arranged around work and family obligations.

The Division of Continuing Education continued its successful program of career counseling using lessons developed jointly with the Counseling Center. Sitting at a PLATO terminal located in Clayton Hall, students may obtain career information and guidance. Available lessons include an on-line version of John Holland's Self-Directed Search; Occupational Information by Title, which allows the student to look at career information on up to 510 different occupations; and, a new addition this year, the Exploring Careers Series. This package was developed by Dr. Richard Sharf at the University Center for Counseling with funding from the Center for Counseling, the Division of Continuing Education, and the Control Data Corporation. This new package is explained in depth in the counseling section of this report.

The Division of Continuing Education is committed to serving its students by increasing the number and availability of its course offerings. The use of courses implemented on the PLATO system is a step toward meeting this goal.

Counseling

The counseling project, which originated in 1976 through funding by the Division of Continuing Education, greatly expanded this year. In July of 1980, Senior Psychologist Richard Sharf received a grant of $50,000 from the Control Data Corporation to complete the Exploring Careers Series and to modify it for the urban/underprivileged population which CDC addresses through its Fair Break program. A second grant of $175,000 was awarded in January of 1981 to continue work on the Exploring Careers Series as well as several other lessons on career development and education.

The Exploring Careers Series is similar to its predecessor, the Career Search. One of the major differences is that the Exploring Careers Series is designed not only to help students explore occupational alternatives, but also to narrow down their choices. Students are guided through this process, which may take two to three hours, by the two cartoon characters shown in Figure 42.

The Exploring Careers Series has three main parts. The first part introduces students to a wide range of careers by asking them to indicate their interest in each of 62 different careers. Unlike other career interest inventories which rely on career stereotypes, this one allows students to look at information about each occupation before making their ratings. Figure 43 shows one of the four pages of ratings that students are asked to complete. Using John Holland's typology, students are given scores in six areas -- Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. On the basis of these scores, students are presented with an ordered list of occupations from which to choose in Part 2.

Figure 42. Exploring Careers: Introduction, by Richard Sharf, Lousia Bizoe, Charles Collings, and Mark Laubach. Copyright © 1979, 1980, 1981 by the University of Delaware.

Figure 43. Exploring Careers Part 1, by Richard Sharf, Louisa Bizoe, Charles Collings, and Mark Laubach. Copyright © 1979, 1980, 1981 by the University of Delaware.

In Part 2 of the Exploring Careers Series, students can see up to 510 jobs from which they can choose two, three, or four that they wish to save and examine further. As Figure 44 shows, there are a number of options available to students interested in learning more about the occupations in order to choose those which interest them the most.

When students have decided which occupations to investigate further, they then proceed to Part 3.

Part 3 of the Exploring Careers Series was designed to help high school students and high school drop-outs be realistic about their career choices. Students are asked to rate each of the two, three, or four occupations on six characteristics: interest in the occupation; attainability of education level; ability to meet qualifications; acceptability of salary; acceptability of working conditions; and the riskiness of the job market. Figure 45 gives an example of the occupational information and the rating instructions.

The Exploring Careers Series was informally tested with fifty students during its development. It is currently undergoing a formal test which will be completed in July of 1981. Subjects for this testing are non-college bound high school students and high school dropouts. A report will be available in September of 1981 detailing the results of the testing of this program.

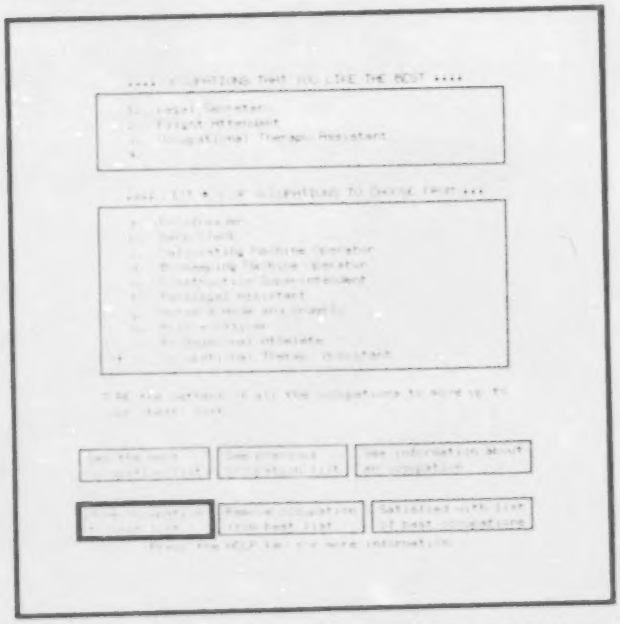


Figure 44. Exploring Careers Part 2, by Richard Sharf, Louisa Bizoe, Charles Collings, and Mark Laubach. Copyright © 1979, 1980, 1981 by the University of Delware.

Figure 45. Exploring Careers Part 3, by Richard Sharf, Louisa Bizoe, Charles Collings, and Mark Laubach. Copyright © 1979, 1980, 1981 by the University of Delaware.

Two new lessons currently under development will serve as alternatives to Part 1 of the Exploring Careers Series. One lesson will enable students to indicate the work tasks they would like to do or are able to do, as a way of generating a list of occupations which can then be used in Part 2. The second lesson will serve as a quick path through the Exploring Careers Series. Designed for those who have already chosen an occupation, it will use the completed Occupational Information by Title lesson to enter the name of an occupation and generate a list of occupations for use in Part 2. These two new lessons will combine with the existing Exploring Careers Series to provide a very flexible method of investigating career choices.

The job information database for the Exploring Careers Series contains brief information on 510 jobs. Occupational vignettes, four of which are currently under development, will provide much more information. For an occupation like welding, a student will study welding tasks, differences in the way welding is performed across several industries, the pay scales for welding, promotional ladders for welders, mathematics used by welders, reading required of welders, and more. Students who use these lessons will learn the nature of the work involved and ways to receive training in the professions.

The major advantage of these occupational vignettes over already existing careers materials is that students may choose the information they wish to study; they are not required, for example, to sit through long film strips or movies. The possibility of utilizing random access videotape in conjunction with these is also being explored.

Economics

Students in the Department of Economics are using two sets of lessons on the PLATO system. The first set, developed at the University of Illinois, is a series of instructional lessons in basic macroeconomics and microeconomics. Under a joint agreement with the original authors, these lessons have been adapted so that they are better suited to the University of Delaware curriculum. Discrepancies in terminology have been resolved, topics have been reordered or omitted, and the explanations and graphs are easier to read.

Figure 46 shows how graphs and questions are used together in a lesson on profit maximization under conditions of imperfect competition to improve student comprehension of a complicated economic relationship. To reach the point in the lesson pictured, the student has answered a series of questions about total cost, total revenue, average total cost, and demand. Each of these functions has been plotted at an appropriate point in the discussion. In response to the series of questions the student has answered, the total profit curve is about to be plotted on the top graph. This in turn will allow the student to read the point of profit maximization from the graph.

A second set of lessons is being developed by the Department of Economics at the University of Delaware. In the current phase of this effort, a large set of multiple-choice practice problems related to basic macroeconomics and microeconomics is being assembled. Figure 47 is taken from one of these problems. The student has responded incorrectly and is being shown an explanation of the problem. Explanations are provided for all possible answers to each problem; students see only the explanations

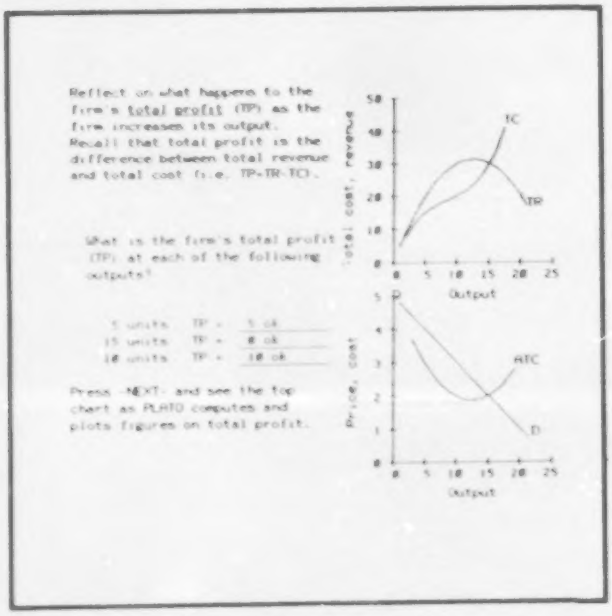

Reflect on what happens to the firm's total profit (TP) as the firm increases its output. Recall that total profit is the difference between total revenue and total cost (i.e. TP=TR-TC).
What is the firm's total profit (TP) at each of the following outputs?
5 units TP =
15 units TP =
18 units TP =
Press NEXT and see the top chart as PLATO computes and plots figures on total profit.
Total cost, revenue
TC
TR
Output
Price, cost
ATC
D
Output

Figure 46. Imperfect Competition, by Donald W. Paden, James H. Wilson, and Michael D. Barr. Copyright © 1975 by the Board of Trustees of the University of Illinois.

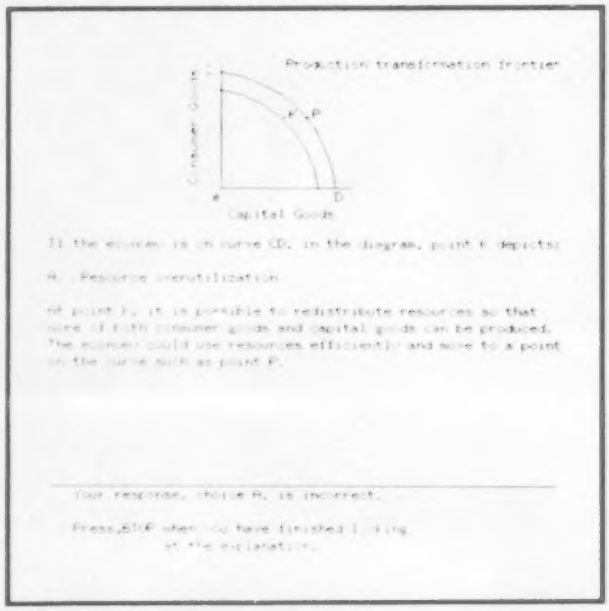

Production transformation frontier
Consumer Goods
Capital Goods
P
D
If the economy is on curve CD, in the diagram, point P depicts:
A. Resource underutilization
At point P, it is possible to redistribute resources so that more of both consumer goods and capital goods can be produced. The economy could use resources efficiently and move to a point on the curve such as point P.
Your response, choice A, is incorrect.
Press STOP when you have finished looking at the explanation.

Figure 47. Economics Practice Problems, by Jeffrey Miller, Lenore Pienta, Keith Slaughter, and Mark Zembrzuski. Copyright © 1980 by the University of Delaware.

which are appropriate to their responses. The structure within which these problems are being implemented will allow individual instructors to select problems from the set and to modify terminology as they see fit. For example, in the set of problems on the Production Possibilities Curve, instructors may specify which problems from the set should be presented for their students and may designate that the terminology "production transformation frontier" be used instead of "production possibilities curve" for their students. By incorporating this measure of flexibility, the designers hope to avoid problems of obsolescence and non-transferability that might make the implementation of several thousand problems unwise if the same problems, with the same wording, were made available to all students.

Another microeconomics lesson under development illustrates the concept of the perfect competitor in the market place. The lesson is designed to help the student who knows the economic theory of the perfectly competitive firm but finds it difficult to understand the mathematics of the firm's cost curves. The student begins by choosing a market price. The computer supplies a partial schedule of costs. The effect of the market price chosen on other key variables is made clear through a series of questions, for example, on the marginal cost of producing at a certain output level and on the return on the investment in the firm. As the student answers these questions, the results are plotted on a graph. In Quantitative Analysis of the Competitive Firm, Figure 48, the student has correctly answered questions pertaining to the marginal cost of producing. Upon pressing NEXT, the student will see the graphical display of each section of this curve.

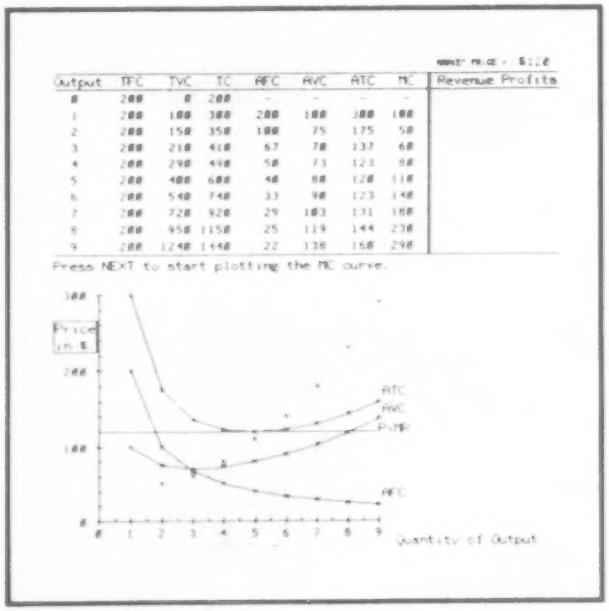


Figure 48. Quantitative Analysis of the Competitive Firm, by Mark Zembrzuski. Copyright © 1981 by the University of Delaware.

Education

A series of PLATO programs was developed by Dr. R. L. Venezky for studying different aspects of the reading process. "Window" is a program that presents text as if it were seen through a moving window. By varying the width of the window and the rate at which the window moves, the experimenter can control the duration of exposure of the text and the amount of text that can be seen at one time. Dr. Venezky is using this program to study the effects of peripheral vision in reading. A second program called "Field" maps the sensitivity of the human visual field by exposing dots of specified duration randomly on the PLATO screen. Subjects indicate detection of a light spot by touching the area where the spot occurred. A third program called "LSC" tests knowledge of letter-sound correspondences with a multiple-choice format.

In the past year a study has been done on the relationship between orthographic structure and letter string recognition. A one hundred and fifty item list of synthetic words in five different linguistic categories was used to study language processing in adult subjects. Words were presented individually in random order at one terminal with responses recorded phonologically by an experimenter on an adjacent terminal. For each word the data print-out included a talley of response time and a percentage of correct responses for each of four alternative responses.

A Text Study Package is currently under development by Dr. Victor Martuza that will allow researchers to study reading patterns exhibited by individuals who are confronted with various types of printed material under a variety of circumstances. With these lessons, the research subject is able to read through newspaper, magazine or text-like materials containing tables, graphs, or line drawings. As the system is being developed, detailed information on reading patterns will be stored by the computer and summarized in graphic form to facilitate analysis by the experimenter. Completion of this series of lessons will permit the study of reading patterns at a level of detail surpassed only by the use of sophisticated, delicate eye-tracking equipment.

A Multi-Dimensional Scaling Survey Package permits Dr. Martuza and other researchers to collect and edit data amenable to analysis by a state-of-the-art multidimensional scaling routine. The lessons present stimuli to the research subject, store the response data, and provide a number of visual displays which permit the researcher to assess the quality of data collected. After editing, the data can then be routinely transferred for analysis using the ALSCAL program on the B7700 system. Using this set of routines, research which is ordinarily difficult to carry out can be done quite easily.

"The Effect of Sample Size on the Sample Variability of Pearson's Coefficient of Correlation" is a statistical sampling laboratory lesson which exploits the unique graphic capabilities of the PLATO system in order to allow students to examine the sampling variation of selected statistics and the relationship between such variation and sample size. This lesson has been used in several courses at the University. In addition to being a useful pedagogical tool, the sampling laboratory provides the potential for doing research on discovery learning.

The Reading Study Center has developed a package of remedial reading lessons designed to teach both "survival" words (words that an adult needs to be able to recognize in order to get through daily life, such as "telephone" and "stop") and words from the Dolch sight word list. The lessons follow a theme involving spies and secret passwords. The basic instructional lesson is called "SWAT" (Sight Word Attack Team).

The Reading Center has also developed instructional games in which the students practice distinguishing the target words from each other. In "Make a Spy," for example, the students' reward for "guessing" the secret message is the chance to select parts of a spy disguise for themselves. The students like to fix sentence after sentence just for the opportunity to make their own funny spy faces. Like all other reading materials developed on PLATO, the SWAT package uses random access audio to deliver instructions and feedback to the student. However, where previously written lessons automatically initiate the delivery of audio, the SWAT lessons use a different strategy known as learner-controlled audio. With learner-controlled audio, all of the directions and feedback are written on the screen. The students initiate the messages by touching the screen when they are ready to listen. After the students have heard a message once, they are able to touch the messages in order to hear them again.

There are three advantages of learner-controlled audio over more conventional programming techniques. First, students are never surprised by messages which they are not ready to hear. Second, students can hear any message again if they need help. Third, since the messages are written on the screen, the students see them many times and become familiar with them. Eventually, the students learn how to read the messages by themselves.

The Hang-a-Spy lesson has been revised to allow a teacher to edit or to change the list of words used. This feature means that the teacher can individualize the lesson to meet the needs of the students.

In a special education project conducted by Drs. Meisel and Smith, samples of mentally retarded autistic and mentally retarded non-autistic children were given a series of short-term recall tasks to test for possible differences between the two diagnostic groups in recall pattern (i.e., the order in which sequentially presented material is recalled). Subjects were shown sets of digits or other stimuli in such a manner that the successive (temporal) order of appearance of each member of a set does not correspond to a left-to-right (spatial) configuration. They were asked to indicate which pattern they had seen from among an array containing a temporally ordered and a spatially ordered set along with one in some random order.

Analysis of the data collected in this project will seek to determine the proportion of responses favoring one order versus another. This will be done to test an hypothesis of no difference between the groups. Additional analyses of differences within the groups will focus on possible relationships between order chosen and receptive language ability of respondents, type of stimulus presented, and rate of stimulus presentation. The outcomes are expected to enhance current understanding of cognitive differences between the two subgroups of disabled children and to have implications both for etiological and clinical diagnosis.

English

The English Department has found PLATO to be a valuable tool for improving writing skills, especially for those students taking the pre-introductory level college English courses taught by the Writing Center staff. Students taking these courses use PLATO lessons developed at the University of Delaware as well as lessons programmed by community college teachers in Illinois in order to strengthen basic skills in punctuation, sentence structure, spelling, paragraph structure, verbs, and verb forms.

During the 1980-81 academic year the Writing Center also coordinated the usage of PLATO lessons in English grammar and punctuation for students in the College of Education who had been recommended to the Writing Center as needing improvement in grammar, sentence structure, and punctuation. A curriculum of ten lessons, each geared to strengthen skills in one of five targeted weak areas, was set up for these students using the library of English lessons available on the Delaware PLATO system.

Figure 49 shows the introduction to an English grammar review developed by Professor Gerald Culley at the University of Delaware which was included in the curricula of both of the above groups.

The long-range goal of the Writing Center project is to complete a package of lessons designed to teach classroom English language skills. This package was begun during the 1978-79 academic year. After taking a diagnostic test of four language features common to speakers of Black English vernacular (and also present in the speech of foreign students of English, especially those with a Hispanic background), the student will be routed to one of five lessons, each of which concentrates on

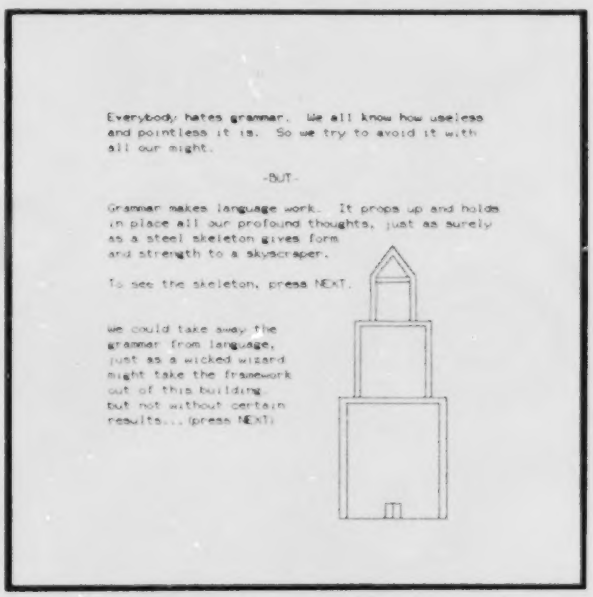

Everybody hates grammar. We all know how useless and pointless it is. So we try to avoid it with all our might.
-BUT-
Grammar makes language work. It props up and holds in place all our profound thoughts, just as surely as a steel skeleton gives form and strength to a skyscraper.
To see the skeleton, press NEXT.
we could take away the grammar from language, just as a wicked wizard might take the framework out of this building, but not without certain results... (press NEXT)

Figure 49. A Review of Grammar, by Dan Williams and Gerald R. Culley. Copyright © 1977 by the University of Delaware.

teaching part of the four language features. At the time of this writing three of these lessons are completed and available for student use. In addition, an editor was completed for an instructional game called, "The Animal Game," which allows the student to choose any of the four language features for additional drill-and-practice in a game format.

Figure 50 shows an introductory screen display from a lesson which teaches third person singular indicative subject-verb agreement. This display introduces the key concept, common to all five lessons in the package, of the distinction between informal and classroom English, illustrating examples of acceptable settings for each.

Figure 51 shows a lesson which teaches students how to make classroom English negative sentences. In this lesson the students are asked to pick out sentences written with double negatives. The students are then told whether they have correctly spotted a double negative. The lesson's feedback then allows the students to change any incorrect response to a correct one, and when the students have successfully spotted all double negatives, the lesson changes the sentences that need changing to classroom English.

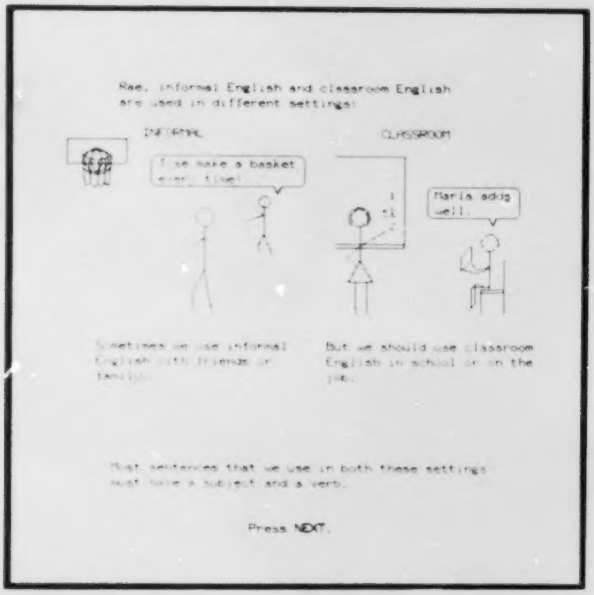

Rae, informal English and classroom English are used in different settings!
INFORMAL
CLASSROOM
Maria adds well.
But we should use classroom English in school or on the job.
That sentences that we use in both these settings must have a subject and a verb.
Press NEXT.

Figure 50. Third Person Singular Verbs, by Louis A. Arena, Phyllis N. Townsend, and Jean Patchak Maia. Copyright © 1980 by the University of Delaware.

Spot the sentences with double negatives.
which sentences would you want to change for the classroom? Touch the circle next to any sentence with more than one "no" word. Touching a circle again will change the mark.
Lola wasn t happy about her science project.
She didn't want to cut up no frogs before lunch.
However, she found she didn't mind it too much.
She lost two pounds because she couldn't eat nothing.
Look again. There s only one negative. You don't need to change this sentence for CLASSROOM ENGLISH.
Touch the circle next to it to change your answer.

Figure 51. The Power of Negative Thinking, by Louis A. Arena, Sophie Homsey, Jessica Weissman, and Rae D. Stabosz. Copyright © 1979 by the University of Delaware.

The Writing Center staff also began work in the fall of 1980 on a lesson which reviews the content of each of the lessons available in the Catalog of English Lessons. It is hoped that this lesson will aid other Writing Center instructors in designing curricula to meet their students' needs. Figure 52 shows the text of a review of "The Word Store" lessons. Each lesson is given a rating on a scale from one to four.

Title: The Word Store I and II file names: wordstor1
wordstor2

Authors: Joan Sweany & Mitsuru Yamada (1974)

Contents:

Word Store I: simple subjects, adjectives, adverbs
from adjectives.

Word Store II: simple verbs, verbs and particles,
'to have', modals, 'to be', passive verbs,
Haiku-main clause verbs.

Each section has 18 items + synonym question.
Both lesson have a (useless) data section and
the same introductory material on subjects & verbs.

HELP is always available; BACK gives review of completed
work in any section, but the directions don't say so.

Despite some confusing stuff, this is a useful lesson
for ESL students because 1.) each question also asks for a
synonym & 2.) the answer is always available. No touch.
Notice: rare chance to drill aj to av and verb +
particles and modals.

rating: ** (wordstor1 -- subjects,aj,& av)
*** (wordstor2 -- verbs)

ratings are on a 1-4 + scale

Figure 52. The Word Store, by Joan Sweany and Mitsuru Yamada. Copyright © 1974 by the City Colleges of Chicago.

Heath Education

The health education project officially started in November of 1979 by sponsoring a notesfile called "sexednotes" in which students can discuss any sexually-related questions. Specially trained sex-education peer educators read and respond to the notes regularly. A multiple student sign-on allows easy student access to "Sex-Ed Notes." Use of this file was so successful that the notesfiles "sosnotes" and "ipr" were added in 1980. S.O.S. members of the campus rape crisis group monitor and respond to "sosnotes" which is intended for discussions of sexual offense concerns. The peer educators monitor "ipr" which is for discussions of interpersonal relationships. All three files allow students to write notes anonymously. In addition to notesfiles, a number of lessons are available from the student/sexed sign-on, some from existing courseware and others developed by the health education project as shown in Figures 53 and 54. Students have logged roughly 2312 hours on the student/sexed sign-on shown below during the 1980-1981 academic year.

A questionnaire evaluating the options of the student/sexed sign-on was placed on-line and one hundred and three people responded. Ninety-two percent felt that the exposure to the variety of attitudes in the notesfiles was a good learning experience.

The health education project has completed a lengthy series of lessons on contraception that are currently in the evaluation stage. Over seventy comments have been collected from students to help perfect the lessons. The index page for these

Figure 53. Sex Education Notes, by Anne Lomax and the Sex Education Peer Educators. Copyright © 1980 by the of Univeristy of Delaware.

Sex Education Resources: Delaware
To see more information on one of the topics below, type the number of the topic and press the NEXT key)
1. Abortion
2. Adoption
3. Contraception
4. Counseling and Therapy
5. Dysfunctions
6. General Health Information
7. Gyn / Female Clinics
8. Help for Sexually-Related Problems
9. Homosexuality
10. Male Clinics
11. Pregnancy and Childbirth
12. Pregnancy Testing
13. Rape and Sexual Assault
14. VD and STD's

Figure 54. Sex Education Resource Network, by Anne Lomax, Mark Laubach, and David Anderer. Copyright © 1980 by the University of Delaware.

lessons and a sample display are shown in Figures 55 and 56. Each lesson includes information on general points, how the method works, effectiveness, advantages, disadvantages, and reversibility.

Lessons dealing with sexually transmitted diseases and local health referrals are currently under development.

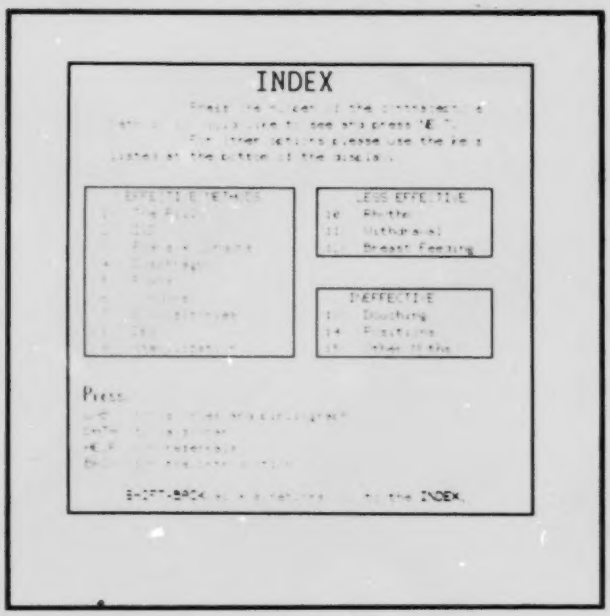


Figure 55. Contraception, by Ivo Dominguez, Jr. and Anne Lomax. Copyright © 1980 by the University of Delaware.

How The Method Works
fallopian tube
(before cutting)
uterus
ovary
vagina
There are more risks involved in sterilization for women than for men because the organs are in the abdomen. Types of tubal ligation vary mostly in the location of the incision. The incision can be made on the lower abdomen, the navel, or through the vaginal wall. Tubal ligation is easier immediately after giving birth.
press NEXT for how sterilization in men.
press SHIFT-NEXT to go to "Effectiveness"

Figure 56. Contraception, by Ivo Dominguez, Jr. and Anne Lomax. Copyright © 1980 by the University of Delaware.

Honors

PLATO became part of the Freshman Honors Program in Dover during the Spring Semester of 1978. With four terminals installed on the Wesley campus, it became a very popular part of the program. Use among the students and staff took several forms. In addition to using PLATO in their classes, some of the students were interested in programming their own lessons. Fifteen honors students became lesson authors. They learned to do drawings, compose music, and make animations. One of the students wrote a game called "Dive Bomber." The player is the commander of a ship which is being attacked by a dive bomber. The player is asked to give an estimate in meters of how far away the plane is. The object of the game is to shoot down the plane before it destroys the player's ship. Each time the player misses, he is told how far he overshot or undershot, and from that information he can calculate the proper distance for the next shot.

Several honors faculty became PLATO authors and designed lessons to be used by their students. One lesson designed for class plots a vector field V = M(x,y)i + N(x,y)j. The student is asked to supply functions M and N. Any valid expressions in x and y may be used. Figure 57 shows the plot of the corresponding vector field. Another faculty lesson written in a game format teaches polar coordinates. In this game the student must aim the cannon of a tank at a target and fire the proper distance to score a hit. The student aims the tank by guessing the polar coordinates (r,θ) of the target. If the target is hit, points are awarded to the student. The goal is to score 4000 points in 20 shots. Some targets are worth more than others, based on the difficulty of the coordinates and the size of the target. Figure 58 shows the result of hitting a target with coordinates (-36,252).

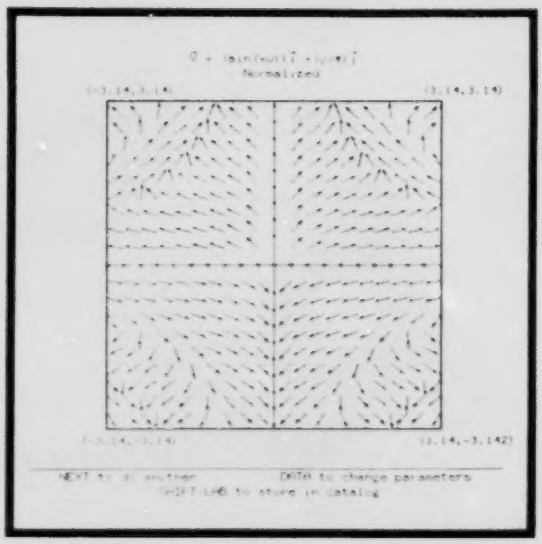


Figure 57. Vector Field Plotting, by Morris W. Brooks. Copyright © 1978 by the University of Delaware.

Figure 58. Polar Coordinate Game, by Alan Stickney. Copyright © 1978 by the University of Delaware.

During the 1978-79 academic year, honors students began to receive academic credit for lessons which they researched, designed, and programmed using topics suggested by faculty members. Two examples are lessons in logic and differential equations.

Figure 59 shows a sample display from the logic lesson. The user types in the premises and conclusions in standard logical notation. The lesson then analyzes the logical argument, checks its validity, and responds with a judgment on the validity of the argument. This lesson also reviews basic concepts in symbolic logic.

Figure 60 shows a sample display from the differential equations lesson which graphically illustrates the Cauchy-Euler method of numerically approximating the solution of an ordinary differential equation. The user is asked to supply a function of two variables f(t,x) and initial conditions. The lesson responds by displaying the graph of the approximating solution. This lesson is useful in studying qualitative properties of differential equations for which it is difficult to obtain analytical solutions.

The PLATO system has also been used extensively in a mathematics curriculum developed by Professors Brooks and Stickney. Partially funded by an Improvement of Instruction grant, this curriculum includes the basic properties of the integral, differentiation, sigma notation, numerical approximation, and root finding. Students are able to use the PLATO system to see their test scores, semester averages, and relative standing in the class.

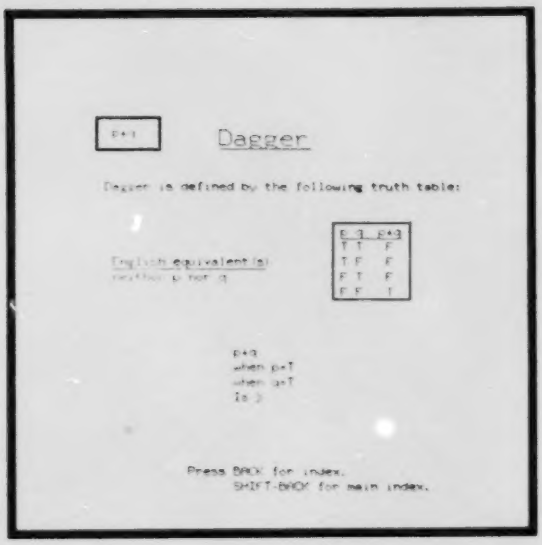


Figure 59. Logic, by Gerard C. Weatherby and Robert Scott. Copyright © 1978 by the University of Delaware.

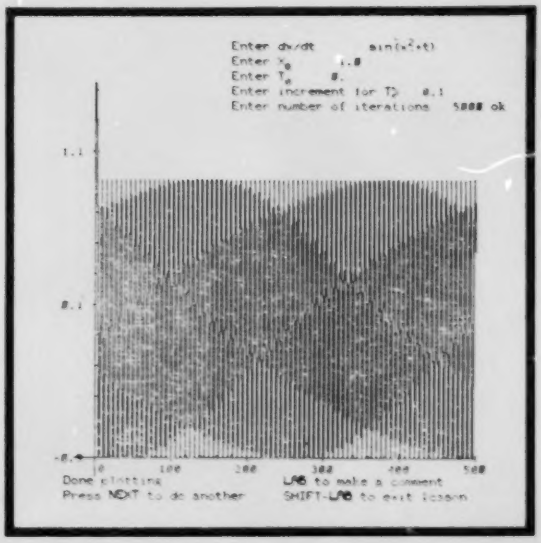


Figure 60. The Cauchy-Euler Method of Approximating Differential Equations, by Tanner Andrews and Stanley Samsky. Copyright © 1979 by the University of Delaware.

During the 1979-80 academic year the Freshman Honors Program was moved to Newark where an Honors Center was set up as part of the University Honors Program. PLATO terminals were installed in the honors library/study area. Students completed assignments for various courses on PLATO, programmed lessons, and used PLATO as a resource for independent or remedial study.

To encourage this independent study, Professor Brooks has written a package of Basic Skills Calculus lessons which allow students to practice problems until they feel that a particular type of problem has been mastered. The Basic Skills I lesson, designed for students in a beginning calculus course, provides practice in finding derivatives of the elementary functions. Polynomials, reciprocal powers, exponentials, and trigometric functions are included. Figure 61 shows a practice session on polynomials. Diagnostic feedback information is provided in anticipation of the most common errors. The Basic Skills II lesson provides drill in elementary anti-derivative problems. The problems are divided into groups of similar kind: for example, monomials, polynomials, and signed exponents. Figure 62 illustrates a test session on exponentials. Students are given two tries to correctly answer each question, and they are considered to have mastered a topic if they have attained a score of eighty or higher.

Figure 61. Calculus Basic Skills I, by Morris W. Brooks. Copyright © 1978 by the University of Delaware.

Figure 62. Calculus Basic Skills II, by Morris W. Brooks. Copyright © 1978 by the University of Delaware.

During the 1980-1981 academic year the PLATO system was utilized in another way by members of the Honors Program. Paul E. Nelson, a student, working with Professor Mike Gage under a research grant from the Honors Program, created a ten-minute film entitled "Rotations in the Fourth Dimension." This film uses the PLATO system to illustrate some complex mathematical ideas by showing shapes and functions rotating on the screen. Figures 63 and 64 show a hypercube and a hypersphere, both of which are rotated in the film.

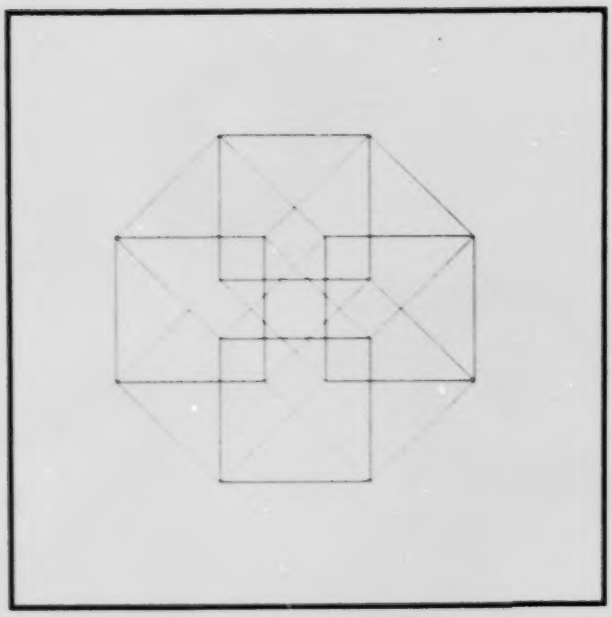


Figure 63. Four Dimensional Rotations, by Paul E. Nelson. Copyright © 1980 by the University of Delaware.

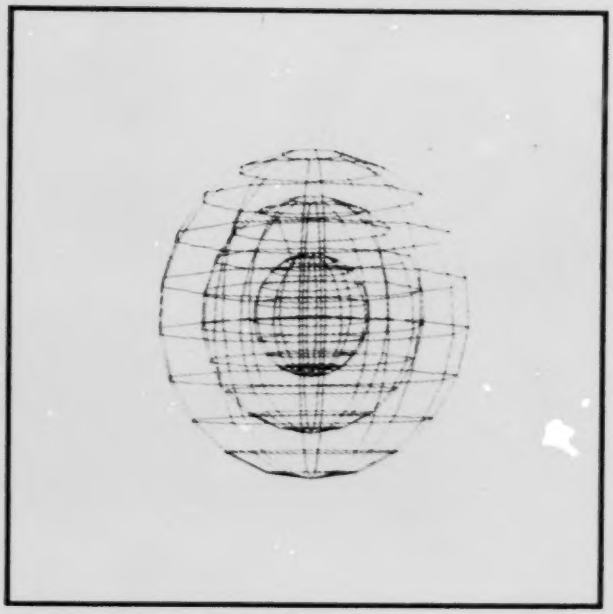


Figure 64. Four Dimensional Function Plotter, by Paul E. Nelson. Copyright © 1980 by the University of Delaware.

Human Resources

Faculty members in the areas of clothing construction, consumer economics, consumer education, architectural drawing, and nutrition have become interested in the teaching and research potential of the PLATO system. A series of lessons on clothing construction that includes metric measurement, body measurement, pattern measurement, ease requirements, alteration practice, fitting, determining pattern size and figure type, and determining needed alterations are being developed and revised.

One of the criteria in lesson development has been to make full use of the special features of the PLATO system. The extensive graphing capabilities of the PLATO system are used in many of the clothing construction lessons, including the lesson on body measurement. In this lesson, the student is presented with a line drawing of a male or female figure with three sets of points, as shown in Figure 65. The student is asked to specify the correct set of points for a given measurement. The student may press HELP to clarify the location of any measurement. The student's answer is judged correct or incorrect, and meaningful feedback is given when errors are made.

Consumer in the Marketplace is a series of lessons presenting fifteen basic consumer economics concepts used in analyzing consumer behavior. The first lesson deals with consumption and explores the concepts of scarcity and utility, as shown in Figure 66. The student learns to make wise purchasing decisions to maximize satisfaction by using a consumption plan model. Other lessons cover consumer education topics such as information gathering, decision-matrix analysis, the consumer price index, the time-probability concept, sovereignty, opportunity cost, and investment in human capital.

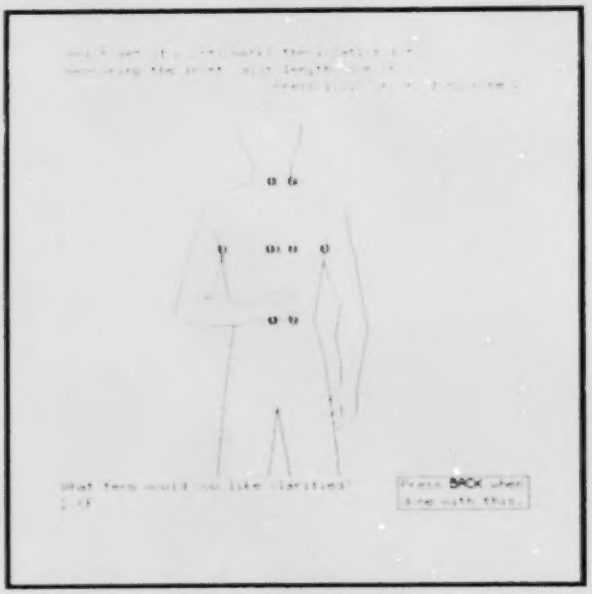


Figure 65. Body Measurement, by Dave Anderer, Kathleen Bergey, Dorothy Elias, Frances W. Mayhew, Bonnie Seiler, and Frances Smith. Copyright © 1977, 1978, 1979, 1980 by the University of Delaware.

WHY THE CONSUMER HAS TO MAKE CHOICES
The concept of SCARCITY is an important one in Consumer Economics. It has a great effect on what and how much we buy.
SCARCITY arises from two conditions:
1. UNLIMITED WANTS and desires, which we all have, on one hand,
vs.
2. LIMITED RESOURCES, such as money, time, and effort, on the other.
WANTS
RESOURCES
Clothes
Stereo
Vacation
Apartment
Car
Time
Money
Effort
Press NEXT

Figure 66. Consumer Education and Consumption, by Kathleen Bergey, James Morrison, Deborah Mellor. Copyright © 1980 by the University of Delaware.

The Consumer Education Resource Network is a guide to available resources on consumer education for use in the state. New resources are frequently added to the network. Another consumer education lesson has been developed which drills a student on the five steps used in a problem solving approach. Figure 67 shows a display from the network lesson where the student is asked to put the steps in order using the touch panel.

In the area of nutrition, a lesson entitled "Weight Reduction Regimens" is being developed. As a part of this lesson, the metabolic basis of hazardous dietary regimens is discussed. Figure 68 shows the student the action of glucocorticoids on muscle, blood, and the liver.

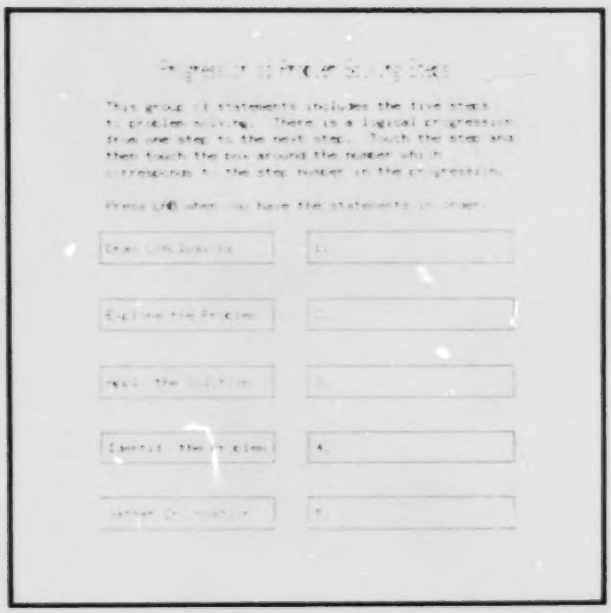


Figure 67. Consumer Economics: Steps to Problem Solving, by Hester Stewart, Nancy McShaw, and Kathleen Bergey. Copyright © 1980, 1981 by the University of Delaware.

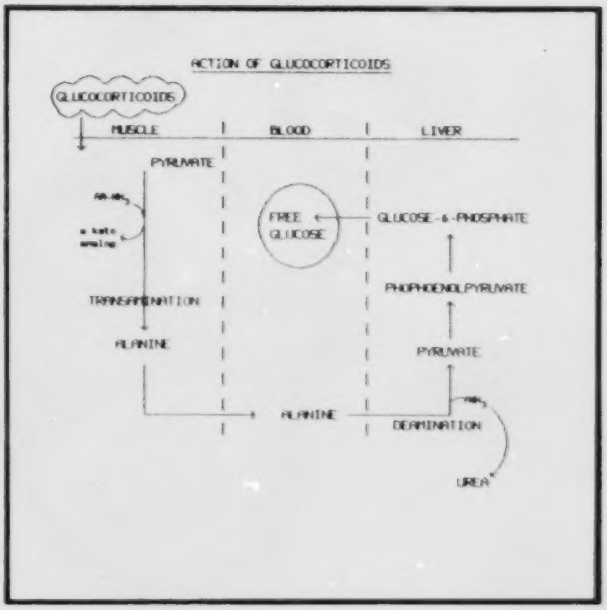


Figure 68. Weight Reduction Regimens, by Leta Aljadir and Phyllis Patton. Copyright © 1980, 1981 by the University of Delaware.

Institutional Research

The University of Delaware's Office of Institutional Research and Financial Planning is using PLATO to produce line and bar graphs for its reports. This year it has produced over one hundred different graphs, examples of which include enrollment projections, tuition comparisons with other schools, and budget information used in the University's request for state funds.

The advantages of the PLATO graphing package are its flexibility and ease of use. Data for graphs are entered using the terminal keyset with the assistance of a powerful editor. No previous computer experience is needed by the user. The information entered can be displayed and labeled in a variety of ways, and printed displays can be obtained using a Tektronix screen copier. As a result, the time required to produce attractive, publication-quality illustrations for the Office of Institutional Research is reduced from many hours when hand-drawn to just a few minutes. Graphs can be stored and then easily updated in subsequent years, a capability that greatly improves efficiency and permits easy analysis of historical trends. A way to combine the graphing package with programs that calculate statistical descriptions and permit statistical analyses of data is being explored.

An example of the output from this project is seen in Figure 69 which shows the percent distribution of current fund expenditure for 1980 for the University of Delaware as compared to private and public institutions.

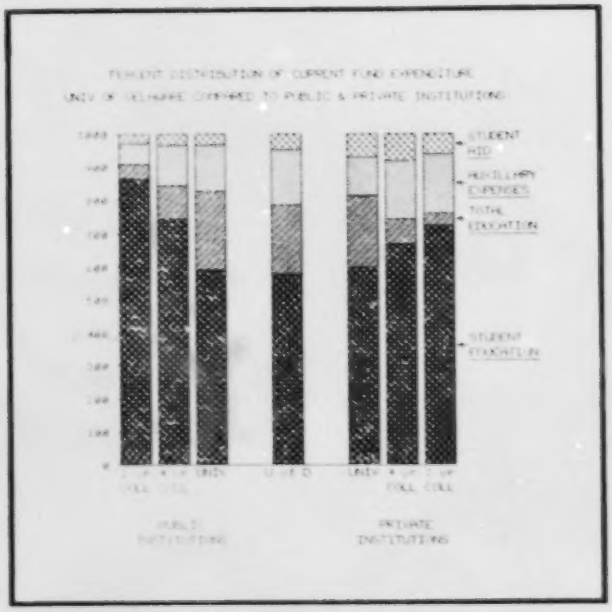


Figure 69. Institutional Research Graphmaker, by Carol Pemberton, Andrew Williamson, Brand Fortner, Aart Olsen, and Mary Jac Reed. Copyright © 1979, 1981 by the University of Delaware.

Languages

Languages faculty members have worked very hard to successfully improve instruction in Latin, Spanish, French, German, and ancient Greek.

One lesson of benefit in learning almost any foreign language is a substitution drill driver being developed by Dan Williams. Its outstanding feature is an editor that guides teachers through the steps of creating their own curricula of drills without having to learn programming or to provide a programmer. The teacher can insert drills in almost any alphabetic language.

Figure 70 shows a drill being written by a teacher of ancient Greek. The lesson has separated the teacher's sentence into a column of words so that the teacher can indicate what the student should do with the sentence. The teacher has underlined the third word, to show that the student will be asked to substitute a different word, and is now putting boxes around the words that the student should change grammatically as a result of the substitution.

The completed drill, as a student sees it, is shown in Figure 71. The model sentence is shown, with an underlined word and the word (in brackets) that the student should substitute. The student has typed the resulting sentence but has made three mistakes. The lesson shows that the first word ends with the wrong kind of letter "s," and that the second word has been given a smooth breathing mark instead of a rough one. The x's under the fifth word mean that it is also incorrect.

Figure 70. Substitution Drill Editor, by Dan Williams. Copyright © 1977, 1978 by the University of Delaware.

Figure 71. Substitution Drill, by Dan Williams. Copyright © 1977, 1978 by the University of Delaware.

Another general-purpose editor is "Underliner," by George Mulford. The instructor inputs a foreign-language passage and its English translation. The program guides instructors through the text, allowing them to underline each word or phrase in turn, to specify its English equivalent, and to append a comment. When the students use the lesson, they may indicate any word by underlining it; the related words of the foreign-language phrase are then highlighted, as is the English translation, and the instructor comment on that word (if any) is displayed. When ready, the students proceed to a quiz on the passage in which words are omitted at random and must be filled in as shown in Figure 72. The quiz may be repeated indefinitely. Each time it is repeated, the words left out include words the students have missed on previous trials, but not words they have typed correctly.

_____autobiographie du bagnard Henri
Charrière, appelé Papillon à cause de _____
tatouage, continue à fasciner l'opinion publique.
L'extraordinaire _____ de son livre, publié en
1969, a révélé le sombre drame _____ bagnards
condamnés aux travaux forcés dans la colonie pénitentiaire
_____ Guyane française. (Voir la carte, pages
54-55.) L'histoire de cette _____ colonie
pénitentiaire a scandalisé l'opinion publique non
seulement _____ France mais dans le monde entier.
C'est en partie _____ aux récits des expériences
de Charrière pendant ses 13 ans _____ prison que
le gouvernement français, pour des raisons humanitaires, a
_____ de liquider cet enfer sur terre où sont
morts 70.000 forçats.
Type the missing word at the arrow or press
HELP to see a single letter or
SHIFT-BACK for the whole text with translation.

Figure 72. Underliner, by George W. Mulford. Copyright © 1980 by the University of Delaware.

Professor Culley has completed a five-lesson Latin curriculum which uses routines to inflect the variable parts of speech. This technique permits PLATO lessons to be very flexible in their responses to student errors because they "understand" the structure of Latin forms. Figure 73 shows a display from "The Verb Factory;" here the student has tried to write the Latin translation of the phrase "you (singular) are well." The typed form "valetis" has been judged correct in stem and tense/mood sign, but wrong in its personal ending. Whenever students have severe difficulty in getting the right answers, the lesson takes them through a checklist of grammatical components to help isolate any problems, and the Verb Factory manufactures the correct verb form, one part at a time. This diagnostic lesson is paired with a verb-form game called "Cursus Honorum" which builds skill in producing and parsing verb forms. The content and skill level are set by the student, a feature which permits continued use of the lesson throughout the year. Both of these lessons have been published.

A third lesson called "Mare Nostrum" applies features analogous to those in the verb lessons to noun-adjective phrases, and a fourth called "Translat" deals with sentence translation. For any word from the 180 sentences it contains, a student may quiz the computer and learn the dictionary entry, the English meaning, the grammatical form, or the word's function in context. Thus freed from the task of juggling dictionary and grammar book, the student can concentrate on the translation process itself.

Figure 74 is from the fifth lesson, "Artifex Verborum," in which a student practices analyzing the words in Latin sentences. After correctly parsing the first six words in this sentence, the student has encountered "milites" and has identified it correctly as a "simple" noun, but then has touched boxes to mark it as masculine

Figure 73. The Verb Factory, by Gerald R. Culley. Copyright © 1978, 1981 by the University of Delaware.

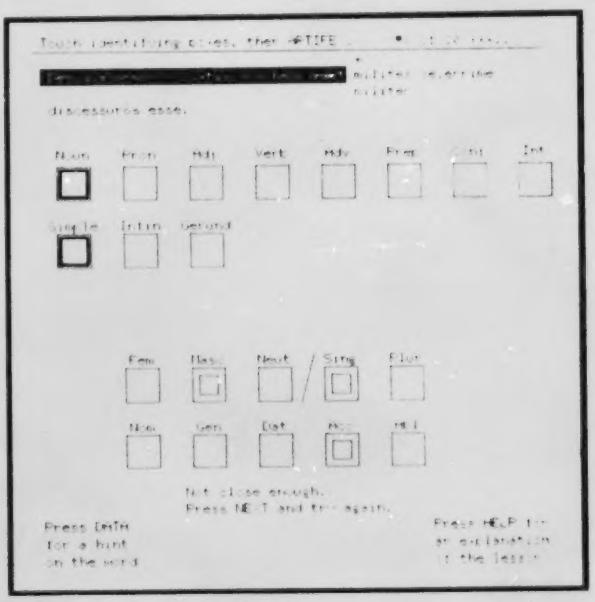


Figure 74. Artifex Verborum: An Exercise in Latin Sentence Analysis, by Gerald R. Culley. Copyright © 1979 by the University of Delaware.

singular accusative, which is incorrect. The lesson has illustrated the error by figuring out what the masculine singular accusative of the word really looks like, and displaying it below the form that the student is trying to analyze.

Touché, a word-order lesson developed by Professor George Mulford, uses the touch panel to help students learn word order in a foreign language. Figure 75 shows how this lesson presents the students with all of the words of the sentence displayed in a scrambled manner in a vertical column. The student is asked to touch the words on the screen in the proper order, building the correct sentence word by word. As the student touches each word, it disappears and then reappears at the top of the screen, as long as the student continues to touch the words in the right order. Figure 76 shows the sentence almost complete. When the last word has been touched, an English translation appears at the bottom of the screen. If the student makes a mistake by touching a word out of order, the screen goes blank and the whole sentence reappears in a newly scrambled order. Using this simple procedure it has been possible to design exercises covering many of the difficulties encountered in the first two years of instruction in French. To correctly complete the sentences, the students must recognize parts of speech, verb agreements, different types of object structure, and the grammatical function of each noun or pronoun. An explanatory display preceding each exercise points out the rules governing the particular word order problem being drilled; the student can recall that display along with the completed correct sentence and its English translation at any time by touching the HELP box.

Figure 75. Touché: A French Word Order Touch Lesson, by George Mulford and Dan Williams. Copyright © 1978, 1979, 1981 by the University of Delaware.

Figure 76. Touché: A French Word Order Touch Lesson, by George Mulford and Dan Williams. Copyright © 1978, 1979, 1981 by the University of Delaware.

Mathematics

The computer-based Mathematical Sciences Teaching and Learning Center was opened for student use in the Spring of 1981. The purpose of the Center is threefold:

1. Improvement of student success in lower division mathematics courses;

2. Involvement of pre-service and in-service teachers and mathematics educators throughout the state in improving the quality of mathematics instruction;

3. Stimulation of research into relevant facets of mathematics teaching and learning.

The Center will utilize a variety of materials and strategies, but it is particularly concerned with computer-based approaches. It houses a classroom with ten PLATO terminals which play a major role in the delivery of both instruction and research. The Center is also keenly interested in evaluating and developing microcomputer-based mathematics courseware. Microcomputers are located in the Center for this purpose.

The Department of Mathematical Sciences has developed a multiple-choice drill lesson which presents a variety of problems to students enrolled in the University's pre-calculus course, math 115. For this one-semester pass/fail course, students attend two lectures each week presented by senior faculty and two problem workshops supervised by senior mathematics students. During the spring of 1981 eleven sections of math 115 used the Math Center classroom for their workshop sessions. In this setting it was possible to combine traditonal classroom instruction with computer-assisted instruction on the PLATO system.

Problems were taken from previously administered exams and were available in the following three formats:

1. Specific Problem Mode -- students could request to work through a specific problem contained in a Sample Exam Test Booklet for sale in the University Bookstore. Solutions to the problem were available in steps.

2. Practice Problem Mode -- students could choose sections from the math 115 text and work through selected problems related to these sections. Solution steps were also immediately available in this mode.

3. Test Mode -- students could take a complete test under timed test conditions. Solution steps were not available until test completion.

In Figure 77, a student has chosen the problem to find cos(-pi). He has indicated choice "d," and his response has been marked incorrect. The student may touch the screen or press the DATA key to see the solution to the problem in steps, as is shown in Figure 78. The student may go through all of the steps of the solution, the last of which gives the correct answer, or may return to the main problem display at any time during the presentation of the solution steps in order to select a new answer.

During the 1979-80 academic year, an experiment was conducted which compared students in workshops using the PLATO system to those receiving only traditional instruction. Initial findings indicate that although the mathematics background of the students in the sections using the problem driver was weaker than that of those in the other sections, more students from the sections using the problem driver passed the course. There were significantly fewer failures in these sections. While the course drop rate was higher, use of the problems on the PLATO system appears to have helped some students determine that their background was inadequate for the course. In addition, student attitudes toward use of the PLATO system were extremely positive.

Plans call for a substantial revision of the problem driver to allow for more flexibility in the choice of problems presented and to provide individualized diagnosis and prescription based upon analysis of student error patterns.

In February of 1981 the University hosted a conference with the goal of founding a National Consortium on Uses of Computers in Mathematical Sciences Education. More than seventy participants from twenty states and provinces of Canada attended. The Consortium is affiliated with the Association for the Development of Computer-Based Instructional Systems (ADCIS) as a special interest group. It will publish a bi-monthly newsletter and will organize sessions on uses of computers in mathematics teaching and learning at the national meetings of ADCIS and major mathematics organizations.

Figure 77. Pre-Calculus Practice Problem Driver, by Ronald Wenger and Keith Slaughter. Copyright © 1978, 1979 by the University of Delaware.

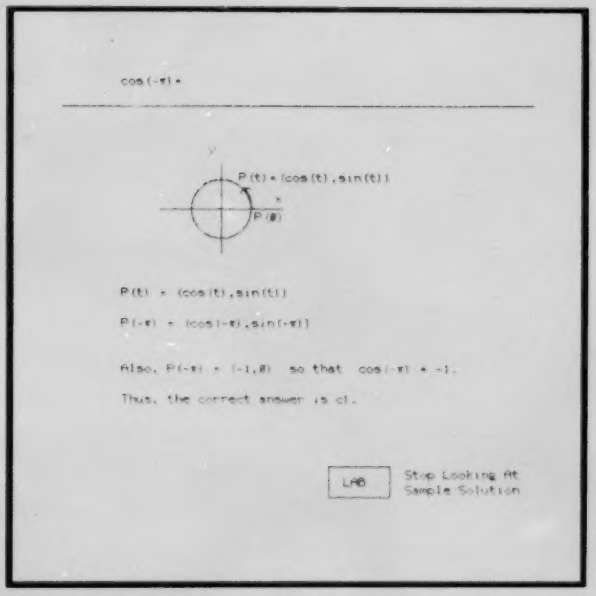


Figure 78. Pre-Calculus Practice Problem Driver, by Ronald Wenger and Keith Slaughter. Copyright © 1978, 1979 by the University of Delaware.

The Math Center has received a grant from the National Science Foundation to conduct a Leadership Training Program on the Uses of Microcomputers in the Mathematics and Science Curriculum. Twenty-four teachers from the State of Delaware with previous experience using computers in the classroom will attend a series of nine workshops and a summer institute on the University campus. These workshops will be conducted by University faculty from the Departments of Mathematical Sciences, Chemistry and Physics. The goal of the program is to prepare the teacher-participants to conduct in-service training sessions for other teachers in their local districts on the use of computers in mathematics and science education.

Museum Studies

The museum studies project was started this year to serve three needs of the graduate and undergraduate students in the museum studies program:

1) To give future museum workers an exposure to computers, since computers are finding increasing use in museums.

2) To show future museum educators the computer as a powerful educational tool, and to expose them to some of the most effective ways in which the computer can provide instruction.

3) To give the students supplementary instruction in topics that will be useful to them in their museum careers, such as professionalism, personnel interviewing, statistics, letter spacing, and the construction of evaluation questionnaires.

Figure 79 shows the options students have in working with the sample evaluation questionnaire. They can create questions, determine how the questionnaire will be administered, or see and analyze responses to the questionnaire.

Currently the museum studies students use existing materials, but plans call for the development of a lesson to give future curators practice in classifying objects under a museum registration scheme.

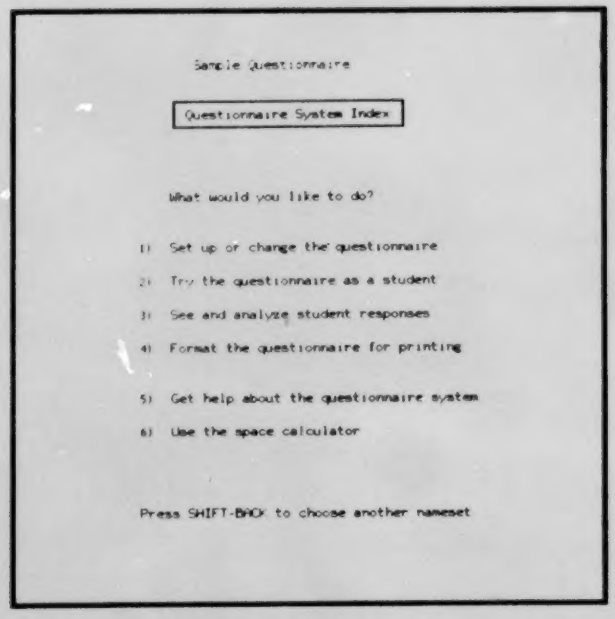

Sample Questionnaire
Questionnaire System Index
What would you like to do?
1) Set up or change the questionnaire
2) Try the questionnaire as a student
3) See and analyze student responses
4) Format the questionnaire for printing
5) Get help about the questionnaire system
6) Use the space calculator
Press SHIFT-BACK to choose another nameset

Figure 79. Questionnaire System, by Daniel Tripp and Bonnie A. Seiler. Copyright © 1978 1979, 1980 by the University of Delaware.

Music

The Department of Music is developing a package of PLATO lessons called the GUIDO music learning system. Guido d' Arezzo is the eleventh century musician and music educator who invented the staff and established the principles of solmization. Since he was the first real music educator, the system has been named after him, using his first name as an acronym for Graded Units for Interactive Dictation Operations. The GUIDO system consists of two main parts, namely, aural skills and written skills.

In the area of aural skills the first two years of ear-training materials have been organized according to levels of difficulty into graded units which form the basis of a competency-based curriculum including drill-and-practice in intervals, melodies, chords, harmonies, and rhythms. Ear-training students spend an average of two hours each week at GUIDO learning stations which consist of a PLATO terminal and a digital music synthesizer.

The basic design of the aural skills programs consists of a three-part process whereby PLATO first displays an answer form on the terminal screen; second, plays a musical example using the digital synthesizer; and third, asks questions about the students' perception of the example. PLATO keeps track of how well the students are doing and issues weekly progress reports to the instructors.

Figure 80 shows a sample display from the intervals program. By studying this display the basic features of the GUIDO system can be understood. At the top are two rows of boxes which contain the names of musical intervals. When the student wants to hear an interval, all he has to do is touch one of the boxes. When he does, the box lights up and the interval designated by the box is played by the computer-controlled

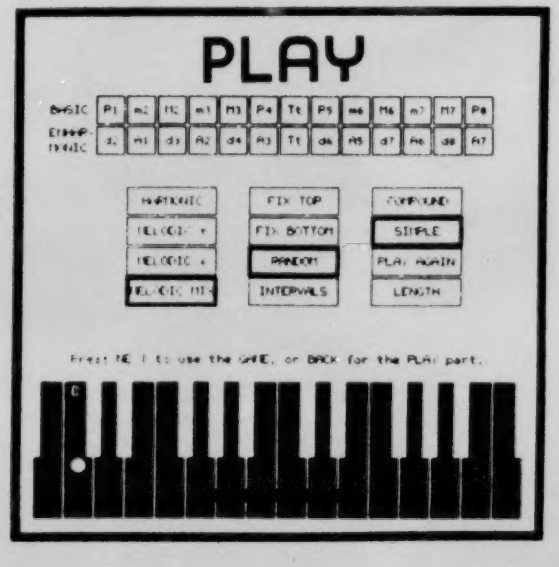


Figure 80. GUIDO Intervals Program, by Fred T. Hofstetter and William H. Lynch. Copyright © 1977 by the University of Delaware.

synthesizer. Conversely, when the student is going through one of GUIDO's formal units, the computer plays an interval, and the student responds by touching the box which contains the interval he thinks was played.

Underneath the interval names are three columns of teacher or student control boxes. These boxes are used to control the way in which dictation is given. The teacher can preset them for the student, or the teacher can allow the students to set them at will. The first column of boxes allows for the intervals to be played as harmonic, melodic up, melodic down, or melodic intervals up and down. The second column gives the option of being able to fix the top or bottom note of the intervals, or to have them selected at random. The box marked "intervals" allows the student to eliminate intervals from the boxes at the top of the screen, so that only some of the intervals will be played. In the third column of boxes the student can select compound or simple intervals, can have an interval played again, and can change the length of time the intervals last. Finally, there is a keyboard at the bottom of the screen. When intervals are played in formal units one of the notes of each interval is shown on the keyboard, and the student is asked to touch the other note played in the interval. In this way, students are quizzed on the spelling as well as on the aural recognition of intervals.

In the area of written skills the music theory division has designed a complete course in written theory based on PLATO learning management. So far, eleven programs have been written and readied for testing with students during the fall of 1980. Dealing with the fundamentals of music, these lessons cover the following topics:

1. Pitch Identification
2. Note Reading
3. Octave Designation Identification
4. Half Steps and Whole Steps
5. Beat Units and Divisions
6. Meter and Time Signatures
7. Intervals
8. Scales
9. Key Signatures
10. Triad Identification and Construction
11. Transposition
12. Chords in Keys
13. Figured Bass Realization
14. Musical terms
15. Partials

Each of these topics represents one module of instruction. For each module, a student has the choice of taking a mastery test, working on drill materials, or reading prescribed pages in a text book. All of the mastery tests and drills are delivered by PLATO lessons.

Figure 81 shows a display from the key signature drill. PLATO shows a key signature and asks the student to touch the tonic on the expanded staff. Figure 82 is from the drill on triad construction. PLATO has given the student the root of a chord and has asked the student to make an augmented chord by touching the right accidentals and notes on the expanded staff. PLATO gives feedback on incorrect responses, gradually helping the student discover the correct answer.

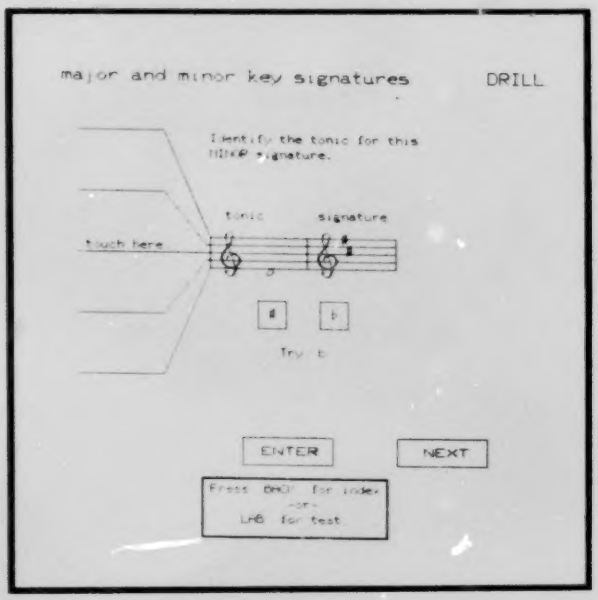


Figure 81. Key Signatures, by Michael Arenson and Patricia Bayalis. Copyright © 1979 by the University of Delaware.

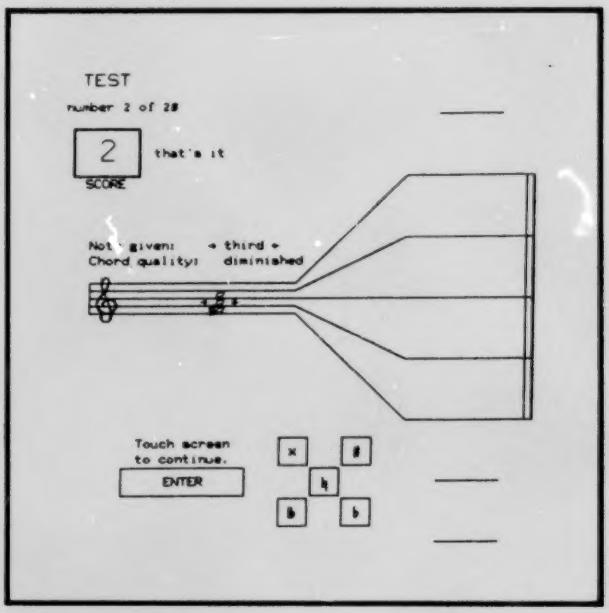


Figure 82. Triad: Identification and Construction, by Michael Arenson and Gary Feurer. Copyright © 1979 by the University of Delaware.

An exciting development during 1980-81 has been the announcement of the new University of Delaware Sound Synthesizer (UDSS). Containing its own Z-80 microprocessor, the UDSS can be used with most any microcomputer or terminal, including all versions of the PLATO terminal. Fully programmable in the domains of frequency and time, the UDSS has thirty-two harmonics for each of its four voices which are optionally expandable to eight voices. Tremolos and vibratos can be made by means of amplitude and frequency modulation, respectively. Glissandos and portamentos can be defined, and programmable memories are included to permit real-time performance controls.

An article describing the background, design goals, features, and ease-of-use of the synthesizer is available from the Office of Computer-Based Instruction, which is producing the UDSS. Copies of this article, pricing information, and more technical information can be obtained by calling or writing to the Office. An orchestration program has been designed whereby students can easily change the instrumentation of the UDSS. Figure 83 shows how they can load ensembles which have already been defined. They can also make up their own ensembles, and they can even create their own instruments. Figure 84 shows how a UDSS instrument consists of a waveform, an amplitude envelope, a frequency envelope, and a glissando factor.

Figure 83. Ensemble Selection in the Orchestration Program, by Fred T. Hofstetter and William H. Lynch. Copyright © 1981 by the University of Delaware.

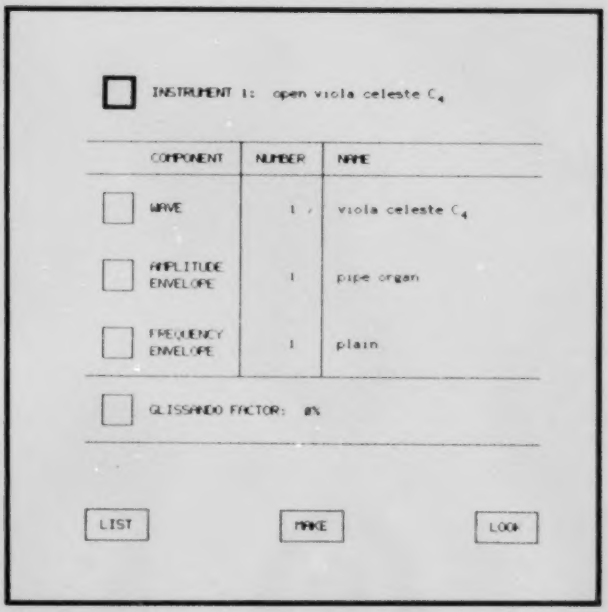


Figure 84. Defining an Instrument in the Orchestration Program, by Fred T. Hofstetter and William H. Lynch. Copyright © 1981 by the University of Delaware.

Students can use waveforms and envelopes which have been predefined by others, or they can make up their own. Figure 85 shows how they can create waveforms by setting the intensities of overtones in a harmonic spectrum, and Figure 86 shows how they can make envelopes by touching points on the display screen. The arrows indicate a loop which will repeat until the instrument rests at which time the decay will occur. By using loops in amplitude envelopes a wide variety of tremolo effects are produced, and by using loops in frequency envelopes, vibratos can be similarly achieved.

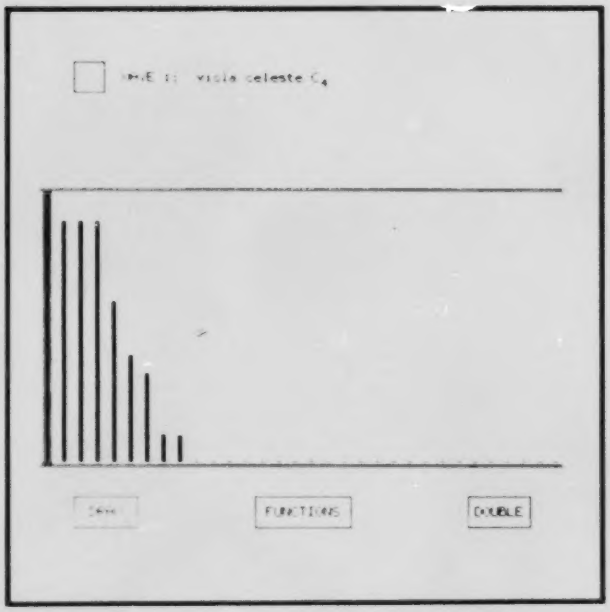


Figure 85. Creating a Waveform from a Harmonic Spectrum in the Orchestration Program, by Fred T. Hofstetter and William H. Lynch. Copyright © 1981 by the University of Delaware.

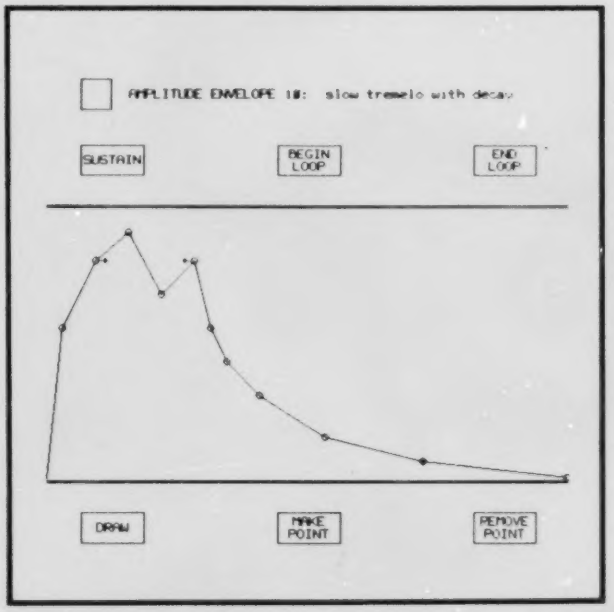


Figure 86. Making Envelopes with Breakpoints in the Orchestration Program, by Fred T. Hofstetter and William H. Lynch. Copyright © 1981 by the University of Delaware.

Nursing

The College of Nursing has developed client simulations for use in conjunction with its adult physical health and illness and its psychopharmacological nursing courses. These simulations offer opportunities for students to utilize skills of analysis, priority setting, problem-solving, and decision-making to simulate delivery of appropriate patient care in response to lifelike client needs. Use of these simulations provides a transition from classroom theory to clinical practice. Students can practice the nursing process without endangering client safety, which makes it possible to stress student learning over timely patient care. Students may work at their own pace, and they may repeat the same clinical situations as often as is necessary to learn appropriate nursing care.

In the situation depicted in Figure 87, a client has returned to his room from the operating room following an abdominal perineal resection. A student has been asked to identify the first in a series of steps which should be taken in response to the needs of the client. The student has chosen a step from a list of steps possible at that point in the care of the patient. The simulation has advised the student that another response would be more timely. In Figure 88, the student has identified an appropriate step and the simulation has indicated a reason for performing that step.

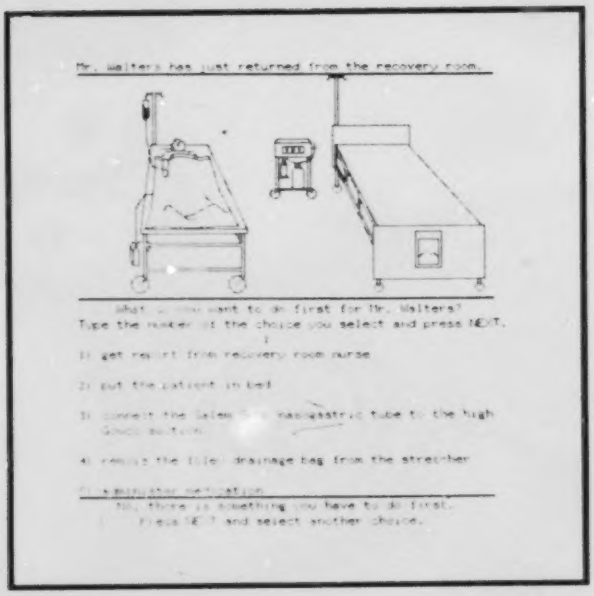

Mr. Walters has just returned from the recovery room.
Type the number of the choice you select and press NEXT.
2) put the patient in bed
4) remove the foley drainage bag from the stretcher

Figure 87. Abdominal Perineal Resection: A Patient Care Simulation, by Mary Anne Early and Monica Fortner. Copyright © 1979, 1980 by the University of Delaware.

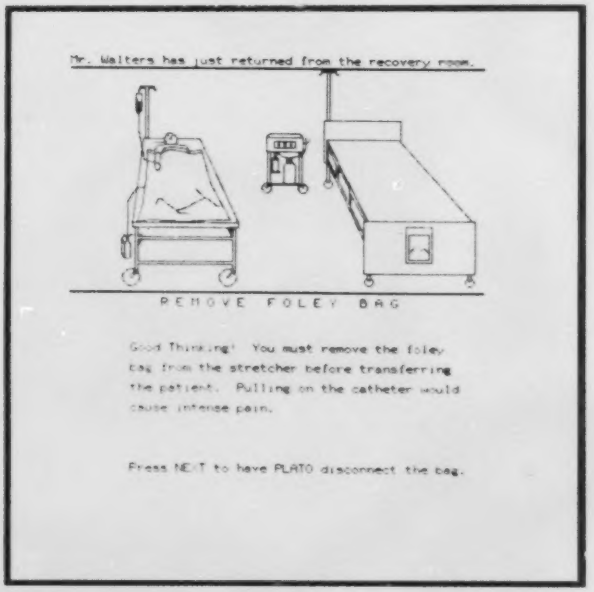

Mr. Walters has just returned from the recovery room.
REMOVE FOLEY BAG
Good Thinking! You must remove the foley bag from the stretcher before transferring the patient. Pulling on the catheter would cause intense pain.
Press NEXT to have PLATO disconnect the bag.

Figure 88. Abdominal Perineal Resection: A Patient Care Simulation, by Mary Anne Early and Monica Fortner. Copyright © 1979, 1980 by the University of Delaware.

In Figure 89, a clinical situation is described in which a client is denying her illness. A student has responded with an appropriate intervention which will help the client avoid irresponsible use of her psychotropic medication. The student is later asked to identify other interventions which may also be appropriate to help the client overcome her denial of her illness.

Four client simulations have been implemented on the PLATO system to date. A fifth has been developed to the formative testing stage (testing with a small group of students). This lesson will be implemented in the fall of 1981, after revision and further testing. A sixth simulation has been designed by Nursing faculty and is awaiting implementation. A research study of the effectiveness of two of the simulations has been conducted and is currently being submitted for publication.

Madeline Lambrecht of psychiatric nursing has been awarded a fellowship by the Center for Teaching Effectiveness. She will design and implement a lesson in Death and Dying, her area of specialization. She plans to use the interactive features of PLATO to encourage her students to focus on a topic that most of them are reluctant to confront. Individualized feedback and branching techniques will allow responses to be handled at the level most appropriate for each student.

The College of Nursing continues to use the PLATO system to allow registered nurses to challenge nursing courses for credit by examination. During the past two academic years, multiple choice tests covering the theoretical portions of the first and second courses in adult physical health and illness have been used a total of 28 times by registered nurses studying for a higher degree.

Finally, the audio-visual technologist of the College of Nursing now maintains on the PLATO system an inventory of all the instructional modules available to students in the media library of the College, as well as the equipment available for delivering these modules.

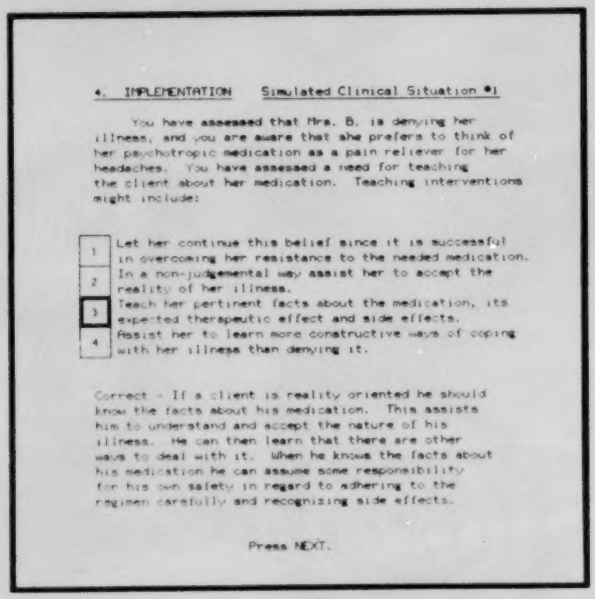

4. IMPLEMENTATION Simulated Clinical Situation #1
You have assessed that Mrs. B. is denying her illness, and you are aware that she prefers to think of her psychotropic medication as a pain reliever for her headaches. You have assessed a need for teaching the client about her medication. Teaching interventions might include:
1 Let her continue this belief since it is successful in overcoming her resistance to the needed medication.
2 In a non-judgemental way assist her to accept the reality of her illness.
3 Teach her pertinent facts about the medication, its expected therapeutic effect and side effects.
4 Assist her to learn more constructive ways of coping with her illness than denying it.
Correct - If a client is reality oriented he should know the facts about his medication. This assists him to understand and accept the nature of his illness. He can then learn that there are other ways to deal with it. When he knows the facts about his medication he can assume some responsibility for his own safety in regard to adhering to the regimen carefully and recognizing side effects.
Press NEXT.

Figure 89. The Use of the Nursing Process in Psychopharmacological Nursing, by Sylvia Alderson, Elaine Boettcher, Kim Buckman and Monica Fortner. Copyright © 1979 University of Delaware.

solution to the problem. The entire package is intended to give students the background necessary to solve these vector motion problems for biomechanics.

In the sport skills area, the volleyball strategies series has been extensively tested. The first lesson, Volleyball Strategies, has been published by the Control Data Corporation. The other two lessons will be submitted for publication this coming year. There is also a series of lessons on doubles racquetball strategies. Offensive and defensive strategies for doubles play are discussed in a three-lesson series. A series of lessons on social dancing is also under development. A musical example is played on a music synthesizer, and the student identifies the dance step that would be appropriate for that example.

Physics

The Department of Physics has been selected to participate in the development of Control Data Corporation's pre-engineering package. Serving as consultants in program development will be Professors Richard Herr, Arthur Halprin, and S. B. Woo. Dr. Herr will also serve on the editorial review board.

The physics component of the program is basically the two semesters of general physics that an undergraduate normally takes at the beginning of an engineering curriculum. There is general agreement on what current textbook is preferred, and it is likely that the organization of the PLATO lessons will parallel that text. The lessons will consist mainly of problem-solving exercises and tutorials in how to do problem-solving, and they will be flexible enough to stand alone or to supplement a lecture course, perhaps replacing the recitation sections that normally concentrate on homework problems. The laboratory experience included in the usual general physics course will remain classroom-based and will not be handled by PLATO lessons.

Students in this year's Introduction to Astronomy used a utility lesson that provides an easily accessible table of the positions of the planets on any date, in right ascension and declination. Shown in Figure 92 is part of the help sequence explaining the terms used in this lesson.

The same astronomy course has also begun some use of microcomputers for instruction. The Department of Physics became involved with microcomputers gradually as more and more faculty members and researchers brought in various personal computers for doing miscellaneous grading and computational tasks. The Commodore PET became especially popular, and about a dozen of them have been acquired during the last year. These have provided about 9,000 hours of computational use for physics research. Instructional use of the PET by astronomy students amounted to about twelve student-hours last year. Programs include an interactive problem-solving lesson on the luminosity of stars, several lessons on Kepler's laws, and some astronomy terminology games, in addition to a utility that students use to analyze their lab data.

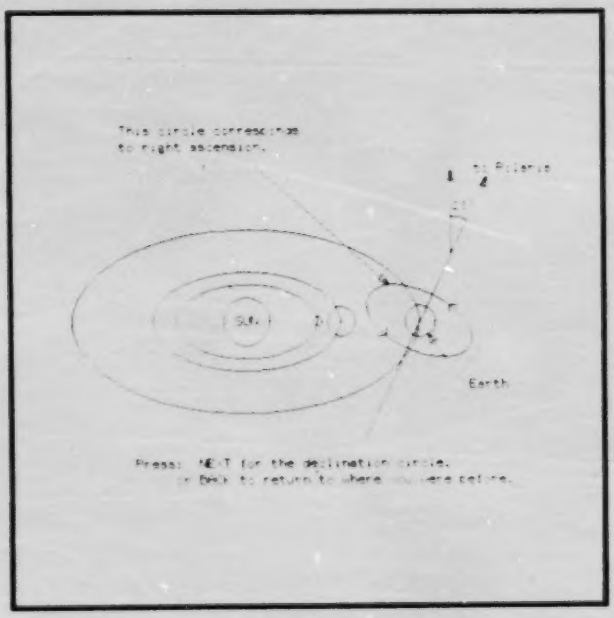


Figure 92. Positions of the Planets, by Samuel Lamphier. Copyright © 1980, 1981 by the University of Delaware.

Political Science

Dr. Richard Sylves of the Department of Political Science has been awarded a Local Course Improvement grant by the National Science Foundation to develop four PLATO simulations. Three of these are based on lessons currently in various stages of completion on the CERL system; the fourth will be developed by Dr. Sylves. All four simulations will allow students to make strategic decisions in the policy process while assuming the role of a key actor in the policy subsystem.

In Dr. Sylves' environmental policy simulation the students will assume the role of a state environmental construction grants administrator. As such they will approve or reject grant applications for the construction of municipal waste water treatment plants. Decisions will be based upon certain conditions of eligibility and constrained by state and federal funding limitations. In their administration of the program students will have to reconcile their efforts to allocate the available funds in terms of objective need with their efforts to respond to a political environment which provides critical agency resources. Partisan influence, committee pressures, legislator seniority, and accountability to the interests and person of the governor are all factors with which the students must contend, as well as various pressures from federal and municipal governments.

At the end of the simulated fiscal year the students will be able to observe how their cumulative grant decisions over the course of the "year" affected the state environmentally, economically, and politically.

"State Budgeting Process," a simulation in which the students play the role of a state agency head for the Department of Mental Health, is one of the three simulations currently under revision and development by Dr. Sylves. The students will complete budget forms for their department and then shepherd their budget through several stages in the state budgeting process as shown in Figure 93. The students must deal

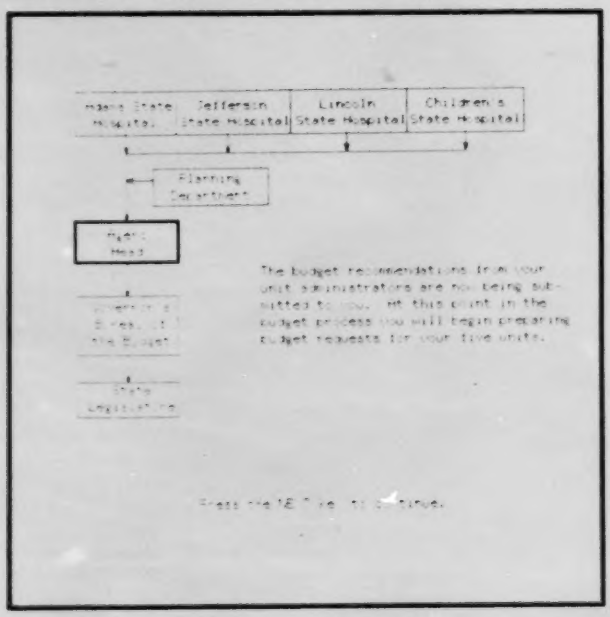


Figure 93. State Budgeting Process, by Fred Coombs, et al. Revised by Richard Sylves, Sue Garton and Kenneth Kahn. Copyright © 1977 by the Board of Trustees of the University of Illinois.

with pressures from the governor, hospital administrators, and key legislators whose districts are served by particular hospitals, and they must also be prepared to justify to the Bureau of the Budget any requested increases in their budget.

The remaining simulations are "Political Districting" and "Committee Chairman." In "Political Districting" the students practice drawing district maps and learn about the political significance of gerrymandering. "Committee Chairman" deals with politicking in the state House of Representatives. The object is to influence House members to vote a particular bill into law. One way to do this is to choose appropriate witnesses who will testify in favor of the proposed bill at a hearing, as shown in Figure 94. Throughout the simulation the students are shown a vote count taken by informal polls. The number of votes in favor, opposed, and undecided are shown periodically to inform students of their progress. At the end of the lesson the students are shown the margin by which their bills passed or did not pass, and they are given examples of some of the good and poor decisions they made during the lesson.

As subcommittee chairman, you have the power to invite witnesses to testify before the subcommittee.
TOUCH the boxes of those witnesses you wish to invite. To change your mind simply TOUCH the box again.
Asst. Secretary of HHS (formerly HEW)
Unaffiliated person from New York City
Young Americans for Freedom (YAF)
National Education Association (NEA)
President of a major university
American Farm Bureau (AFB)
Natl. Council on Higher Education (NCHE)
Heritage Foundation
Office of Management & the Budget (OMB)
American Federation of Teachers (AFT)
TOUCH another box to invite someone else
OR
press SHIFT-NEXT when done.

Figure 94. Committee Chairman, by Fred Coombs, et al. Revised by Richard Sylves, Sue Garton and Kenneth Kahn. Copyright © 1977 by the Board of Trustees of the University of Illinois.

Psychology

The Psychology Department uses instructional computing for both teaching and research. In teaching, "Memory Experiment," "Short Term Memory," "Mental Imagery," "Direct Scaling," and "Reaction Time" are a package of five lessons used as a requirement for psychology students at the University of Delaware. Various aspects of sensation and perception are included, from classical perceptual illusions to the physiology of the eye. Figure 95 is a triangle magnitude experiment from "Direct Scaling." Data is collected as to how the student responds to a series of size comparison questions.

During 1980-81, several new instructional lessons were developed. "Conservation" is a lesson about Piaget's stages of understanding perception. The student proceeds through Piaget's three stages that are demonstrated with tutorials and simulations. Responses are compared to those of children in each stage so that the student is made aware of the child's development of conservation concepts. The third stage requires estimations to be made by the student and judgement of optical illusions, both of which demonstrate that adults have difficulties with some aspects of conservation.

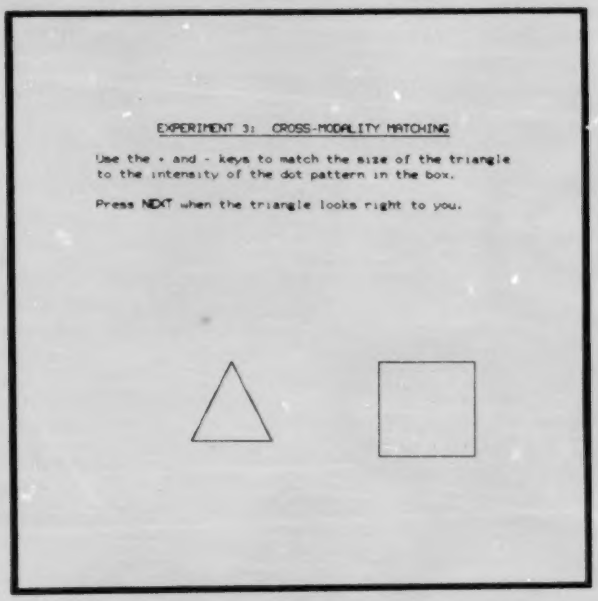

EXPERIMENT 3: CROSS-MODALITY MATCHING
Use the + and - keys to match the size of the triangle to the intensity of the dot pattern in the box.
Press NEXT when the triangle looks right to you.

Figure 95. Direct Scaling, by James Hoffman, Jessica Weissman, Michael Frank, and Robert Krejci. Copyright © 1980, 1981 by the University of Delaware.

Figure 96, found in stage two, illustrates an introduction to the concept of transformation.

Another lesson under development is part two of "Memory Experiment." Part one, used in a self-contained student laboratory in sensation and perception, presents students with a list of words and allows them to arrange them in any manner that would facilitate their memorization of them. After a study period, students are asked to recall the words. Part two of the memory experiment is to be completed by the students no less than seven days later. Data is collected as to how the students originally categorized the words and is compared to the delayed recall success.

Figure 97 illustrates how the students can easily arrange the words in categories on the screen.

In psychological research, the PLATO system has played a crucial role in a two-year project on individual differences in cognitive abilities funded by the Office of Naval Research under the direction of Professor James Hoffman of the Psychology Department. This research is directed at measuring the ability of people to perform simultaneous mental activities with the long range goal of specifying selection and training procedures to maximize "time sharing" ability. The experiments require human subjects to perform difficult simultaneous visual discriminations. The microprocessor-based PLATO V terminal allows precise timing of visual displays as well as subjects' response times.

In the past year a sound generator has been developed and is currently being used in simultaneous auditory and visual discriminations with the PLATO system. This audio peripheral enables the precise selection of tone stimuli for sine, triangle and square wave forms over a wide range of frequencies and intensities. Also available and useful for tone masking is the superimposition of white noise of variable intensities.

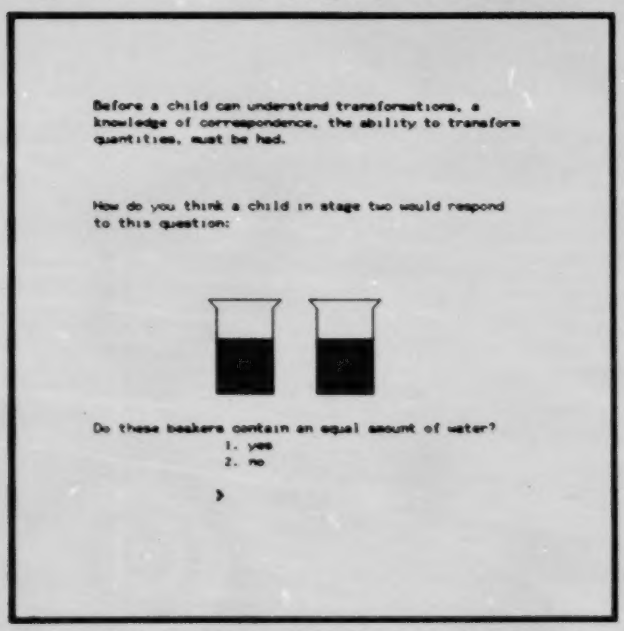

Before a child can understand transformations, a knowledge of correspondence, the ability to transform quantities, must be had.
How do you think a child in stage two would respond to this question:
Do these beakers contain an equal amount of water?
1. yes
2. no

Figure 96. Conservation: Piaget's Stages of Understanding Perception, by Clare Berrang. Copyright © 1981 by the University of Delaware.

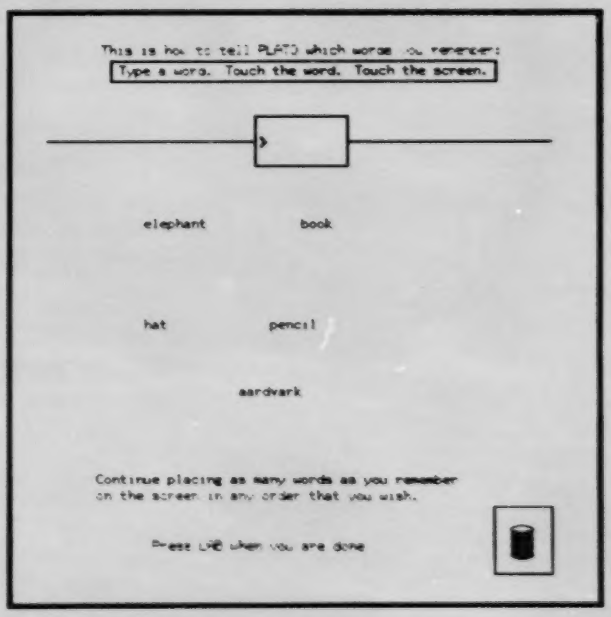

Type a word. Touch the word. Touch the screen.
elephant
book
hat
pencil
aardvark
Continue placing as many words as you remember on the screen in any order that you wish.

Figure 97. Memory Experiment, by John McLaughin, Judy Sandler, and Clare Berrang. Copyright © 1981 by the University of Delaware.

Results collected to date indicate that even extensive training on visual discriminations resulting in "automatic" performance on these tasks does not eliminate between-task interference. Evidently even highly practiced and automatic tasks utilize a limited pool of "mental resources."

The work currently underway involving auditory as well as visual discriminations will help to determine if different modalities compete for the same pool of resources. Of special interest will be the comparison with trade-offs obtained when subjects perform two tasks in the same modality.

A new experiment has been designed to test the effect of "depth" on spatial facilitation/inhibition of target letter identification. Figure 98 shows one of the displays simulating a corridor in which signs are placed at various distances. Subjects must decide quickly if a "K" or "L" is in the middle sign. There is already evidence that opposite response target letters will slow an identification if close to the target. The interest here is if the same effect holds only for same "depth" proximity.

The PLATO system will also be used in experiments involving evoked brain potential measurements. Electrical activity of the brain will be recorded from the scalp in response to computer-generated visual and auditory stimuli. The resulting "average evoked response" should reveal important clues concerning those brain structures involved in attention and learning.

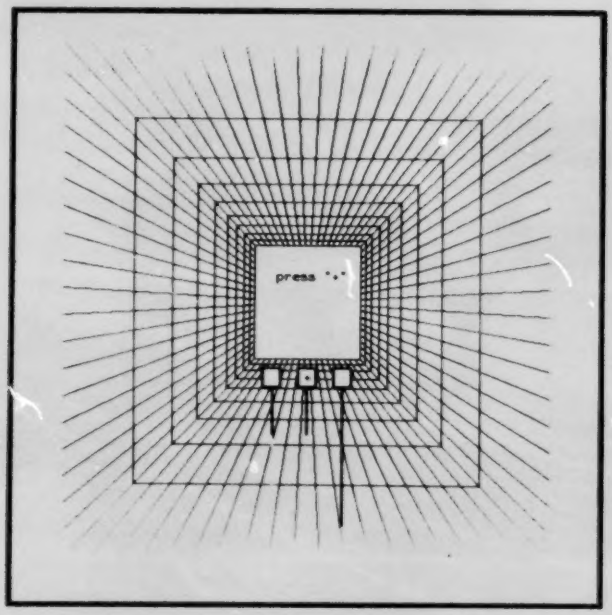


Figure 98. Visual Depth Perception, by James Hoffman and Michael Frank. Copyright © 1981 by the University of Delaware.

Statistics

The OCBI statistics project is continuing to provide statistical instruction and statistical data service to users of the Delaware PLATO system. Interest in using PLATO in statistics has expanded and faculty feedback and suggestions for lesson development are being incorporated into the current statistics package.

A complete library of instructional statistics lessons developed at the University of Illinois is available on the Delaware PLATO system. Interested students and faculty may use statistical packages developed at the University of Illinois to perform analyses of their own data. Graduate students find the instructional lessons helpful for review of fundamentals of statistical analysis, while researchers appreciate the ease with which results may be obtained from the statistical pckages for projects which involve small amounts of data.

The statistics project at the University of Delaware is currently designing and programming a multi-disciplinary, multi-level statistics package which will serve the needs of beginning students, advanced students, and faculty researchers. Several levels of access are provided. For the novice, the statistical tests available in the package are displayed on indices, and students answer questions to provide data needed for these tests. More experienced users may use computer commands to choose statistical tests and to input data.

Basic statistical concepts are taught with the aid of tutorial lessons. Instructors can make available statistical populations with realistic characteristics. Through exploratory data analysis, students can sample from these populations and run meaningful statistical tests on them. Students can enter and manipulate their own data and display graphical representations of their statistical analyses. Students may easily change any of their data items, repeat the analyses, and display new graphs

Figure 99 shows a linear regression plot from a lesson currently under development at

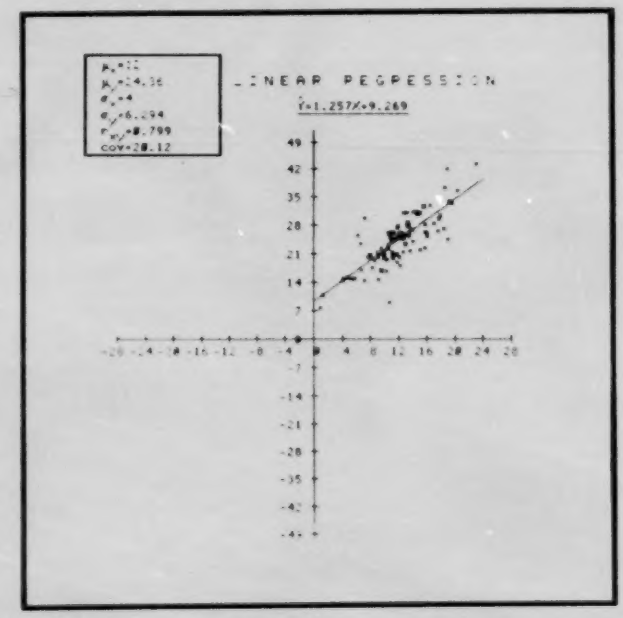


Figure 99. Statistics Worksheet, by Victor Martuza, Aart Olsen, Mary Jac Reed, and Gary Feurer. Copyright © 1980, 1981 by the University of Delaware.

Delaware. The data has been entered in a worksheet format of rows and columns, and thus the data can be conveniently indexed, cross-referenced, statistically tested and compared. Students can obtain a display of the values of a given column of data in many ways: as a table of values, as box plots, or, as shown here, as a scatter plot. Pertinent parameters are shown along with the graphical display.

Student Organization and Activity Center (SOAC)

The SOAC project was established during 1980 to serve the needs of student organizations on campus. Development has occurred in two areas: lessons and notesfiles. The first lesson, Budgetary Procedures for Registered University Student Organizations, is being programmed by a volunteer student. Figure 100 shows a portion of the lesson that explains criteria used for budget allocations. Also under development is an exercise in evaluating student leadership style.

The SOAC project has also established a notesfile, "SOAC Notes." Each registered student organization on campus may announce any activity that it is sponsoring. Students on campus may read the file to check on events for the coming week. Figure 101 shows an example of an announcement in this notesfile.

Figure 100. Budgetary Procedures, by Marilyn Harper, Robin Bryson and Patricia Bayalis. Copyright © 1981 by the University of Delaware.

SOAC NOTES
Note #3 (gsu coffeehouse)
9/14/81 12:21 pm gsu / soac
• Delaware Gay Community Coffeehouse •
Friday September 18, 1981
8:00-12:00 pm
Daugherty Hall
Last Friday's Coffeehouse was very well attended and lots of fun. Try to make it this week. Everyone is welcome at the Coffeehouse. The secret of its success is music, munchies, madness. If you'd like more information visit the GSU office on the third floor of the Student Center, room 303 or call 738-8866.
NEXT for next note

Figure 101. SOAC Notes, by Marilyn Harper. Copyright © 1981 by the University of Delaware.

University of Delaware English Language Institute

The University of Delaware English Language Institute (UDELI) offers an extensive English program to sixty students each month from Panama, Japan, Brazil, Greece, Iran, Mexico, Jordan, China, Korea, Kuwait, Lebanon, Saudi Arabia, United Arab Emirates, Syria, Bolivia, Venezuela, Sri Lanka, Thailand, and Uruguay. Students are placed in one of five levels according to their language abilities.

At the core of the Institute's PLATO curriculum are "Basic Reading and Language Skills" for use by students at the lower levels and the "Index of English Lessons" for intermediate and advanced students. In Figure 102 the student is presented with a verb stem, in this case "look," and is shown endings which change the verb to present tense, past tense, and present participle. Then the student is given new verb stems and is asked to add the correct endings to form other tenses. A group notesfile called "UDELI News" is used by students with the stipulation that all notes must be written in English. In the beginning sections students work with the sounds of letters. In Figure 103 the student learns whether the letter "c" is pronounced like K or like S. In the advanced section students are given PLATO assignments that help to develop skills which they will need in regular University courses.

PLATO is a great success in the Institute. The students who come from traditional educational backgrounds view PLATO as the type of technological methodology that they have come to the United States to experience. They further appreciate the opportunity PLATO offers them to learn at their own pace and in their own subjects. The Institute faculty perceives PLATO as a valuable tool which supplements their teaching and maintains student interest.

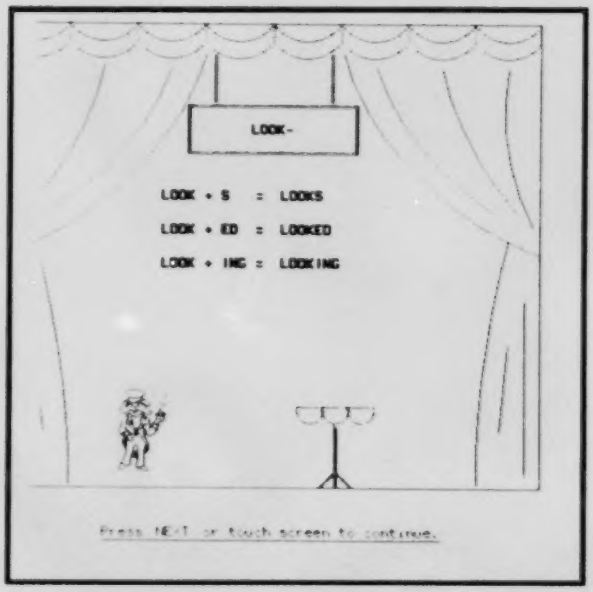


Figure 102. Simple Verb Endings, by Robert Caldwell and Research for Better Schools. Copyright © 1979 by Control Data Corporation.

Figure 103. The Case of the Curious C, by Joan Sweany. Copyright © 1975 by Chicago City Colleges.

University Parallel Program

In the fall of 1980 services began in the University's Parallel Program at the Georgetown campus of Delaware Technical and Community College. Under the direction of Mr. John Gil, an accounting and economics professor, four terminals were installed at the Georgetown campus and were used by students in November of 1981. PLATO was used in accounting, economics, French, sociology and English courses.

In February of 1981 a junior analyst was hired by the Parallel Program to manage the Georgetown site. During the spring of 1981, usage increased as students in computer science, education, business, English and electronics began to use PLATO. Lessons in business, particularly simulations such as the "Advertising Game" and "Restaurant," were enthusiastically used by students in the business course. Demonstrations of PLATO have also been provided to several public school groups from the area.

Work has begun on development of a new remedial spelling lesson which will allow instructors to input their own word lists. Preliminary work is also being done in designing lessons for sociology by Professor Henry Nyce.

Urban Affairs

Students in the College of Urban Affairs are using lessons developed at the University of Illinois to further their understanding of a variety of subjects including statistics, population dynamics, financial management and decision making.

Mathematics lessons give the students an opportunity to learn and practice fundamental computations. These include working with matrices, eigenvalues and eigenvectors as well as statistical information such as analysis of variance, Pearson-product moment correlations, and multivariate analysis.

The Population Dynamics Package provides the students with data on demographic, social and economic variables for 130 countries. This information can be viewed separately or combined for comparison studies. The graphs display the data clearly, enabling the students to study trends and cycles.

The two displays shown below are from a lesson on population projection. Figure 104 shows how a student can change a population variable and observe the results in bar graphs. Following the student's instructions, PLATO has shown on the left side of the display what the population of Belgium would be in 1990 if a dramatic increase in the fertility rate were to occur, whereas the projection of the population of Belgium given the present value of the paramter is shown on the right side of the display. Figure 105 shows how the student can compare the projections for two different countries. In this case the student has asked to see the projections for the

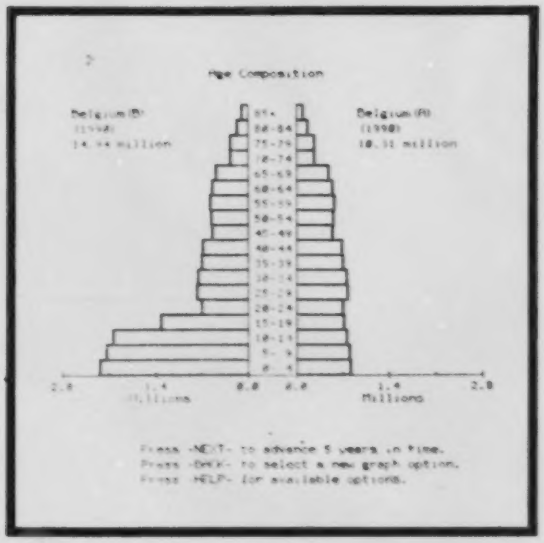

Age Composition
Millions
Millions
Press -NEXT- to advance 5 years in time.
Press -BACK- to select a new graph option.
Press -HELP- for available options.

Figure 104. Population Projections, by the Populations Dynamics Group. Copyright © 1975 by the Board of Trustees of the University of Illinois.

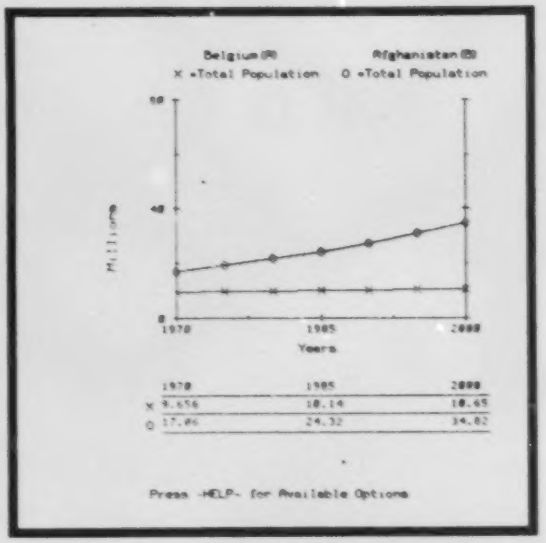


Figure 105. Historical Population Growth, by Paul Handler and R. Rutherford. Copyright © 1976 by the Board of Trustees of the University of Illinois.

populations of Belgium and Afghanistan using current demographic parameters. As with the previous example, the student can change the demographic parameters and observe how these changes effect the populations.

Many of the management and decision-making lessons are set up so that the student is presented with a typical conflict situation which must be resolved by a manager. These small simulations give the student a chance to develop management skills. Topics include time management, women in the work environment, appropriate interaction and feedback for others, and dealing with people you supervise.

Utilities

Since the beginning of OCBI, members of the staff have written lessons which are independent of specific academic disciplines and are in some cases not directly instructional in nature, but yet provide a valuable service to University students, faculty, or staff. Six such lessons, called utility lessons, are described here.

A utility lesson which has proved very helpful both to faculty and to their students who are new to the PLATO system is one entitled "How to Use PLATO." This lesson offers an interactive introduction to many features of the PLATO system, including the special function keys on the terminal keyset and the terminal touch panel. Faculty members may select which sections of the lesson are appropriate for the students in their courses. A language professor, for example, would be interested in teaching his students how to specify vowel and consonant markings in their responses, whereas a professor of mathematics would want his students to learn how to type complex numerical expressions. Figure 106 shows a sample display from the lesson in which students are taught how to use the DATA and LAB special function keys.

Another utility which faculty members find useful is the "Questionnaire System," which allows easy entry of survey items in both multiple-choice or open-ended formats. Questionnaires constructed and administered on the PLATO system typically ask students to evaluate specific instructional lessons or, at the end of an academic term, the appropriateness and usefulness of incorporating PLATO lessons into the syllabus for a given course. Figure 107 shows a student responding to an open-ended question which asks what he liked about using the PLATO system.

DATA and LAB keys
Two more keys, DATA and LAB, are used in some lessons to make special information or options available to you. In fact, what these keys do depends ENTIRELY on the lesson you are working in.
It's a good idea to check the screen for messages (like the one below) on which "special function" keys are working and what they will do.
Press DATA to make the DATA key blink
Press LAB to make the LAB key blink
Press NEXT to continue

Figure 106. How to Use PLATO, by Jessica Weissman. Copyright © 1976, 1977, 1979 by the University of Delaware.

Question number 27
What have you liked most about PLATO?
Write your response in the space below. Press:
NEXT for the next line
SHIFT-NEXT when finished
BACK for previous line
HELP for more options
I liked the way PLATO called me by my name.
Press: ANS to record this answer
BACK to change your answer

Figure 107. PLATO Users Question Survey Package, by Daniel Tripp and Bonnie A. Seiler. Copyright © 1978, 1979, 1980 by the University of Delaware.

After administering a questionnaire, a faculty member can look at all responses to open-ended questions and at summary data on multiple-choice format questions. Summary data includes for each question the total number of responses, the mean response, the standard deviation, the number of times each response was given, and the percentage of the total number of question responses represented by the number of times each response was given.

One set of utility lessons developed at the University is used extensively by students, faculty, and staff. Entitled "The UD Catalog System," these lessons allow PLATO users to create, maintain, and utilize lesson catalogs. Each catalog can be a simple index of lessons or may contain a major index with several sub-indices; multi-page descriptions of each lesson may be included. The catalog system provides the capability to format and print an off-line catalog as well. When a catalog is set up as a router for students, a menu of lesson choices from which students may freely choose is available, and a record is kept of student progress in the lessons chosen.

More than fifty catalogs grouping lessons by subject matter have been compiled on the Delaware PLATO system to aid users in locating lessons they would like to use. Figure 108 shows the first page of a catalog which consists of lessons developed at the University. The catalog has been divided into several sub-indices (called "categories") to make it easy to find lessons in a particular academic discipline. If a user chooses option "a," accounting lessons, he will be taken to an appropriate sub-index display where he may choose to see a particular accounting lesson.

The "Classroom Scheduler System" is a set of utility lessons used by OCBI staff to coordinate group and individual reservations to use terminals in the three major PLATO

Lessons Developed at the University of Delaware
Categories of Lessons
Page 1 of 2
a - Accounting
b - Agriculture
c - Art and Graphic Design
d - Anthropology
e - Biology
f - Career Education
g - Chemical Engineering
h - Computer Science
i - Economics
j - Education
k - Education Research
Choose a letter, or press one of these keys:
SHIFT-STOP to leave
NEXT for more lessons
HELP is available
This catalog was last changed at 21.15.05 on 06/13/80.

Figure 108. UD Lesson Catalog Package, by David Anderer and Bonnie A. Seiler. Copyright © 1978, 1979, 1980 by the University of Delaware.

classrooms, up to two semesters in advance. These lessons help classroom site directors allocate terminal resources efficiently and ensure that a classroom is never over-booked. Several informative displays are available, including a daily schedule of reserved terminals, a list of available terminals, and a weekly schedule of classroom assistants.

A related set of utility lessons collects data on the numbers of terminals used each hour at each PLATO site and the amount of computer memory used during that hour. This information is used in making decisions on placing terminals where they can be used most effectively and on optimizing scheduling arrangements. Figure 109 shows a sample display of terminals used, memory used (in thousands of computer words), and percentage use of computer resources on one day. This set of lessons interfaces with the classroom scheduling lessons in order to facilitate comparisons of scheduled usage and actual usage.

Another utility was developed for Office use to allow part-time employees to record hours worked, broken down by work activity. At the end of each pay period, payroll report forms may be printed and submitted to the University payroll office.

Several other utility lessons have been developed including a diagnostic test question driver, an equipment inventory, an appointment reminder, editors for memos and other short documents, and lessons which make it possible to locate any terminal in the University PLATO network.

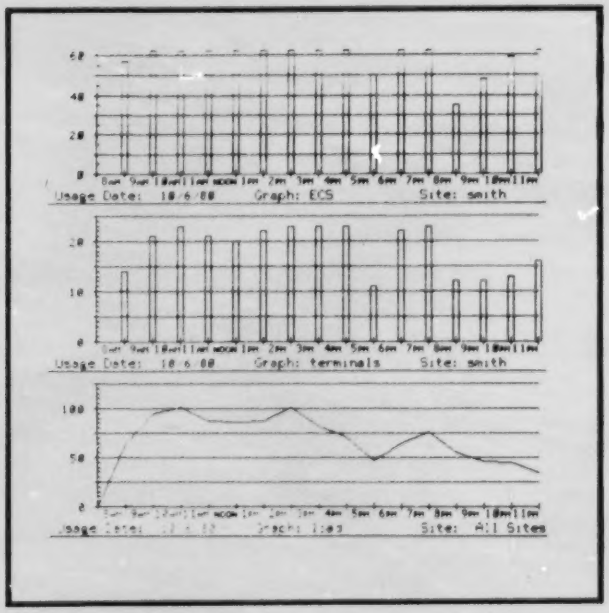


Figure 109. UD Usage Summary, by James H. Wilson. Copyright © 1978, 1979 by the University of Delaware.

CHAPTER III. OUTSIDE USER APPLICATIONS

In addition to supporting campus use, the Office of Computer-Based Instruction offers a variety of PLATO services to users outside the University such as elementary and secondary schools, hospitals, government agencies, businesses, other universities and nearby communities and community agencies. These services include:

- Subscriptions for computer services
- Courseware development
- Workshops
- Consulting services
- Demonstrations
- Use of University classroom facilities
- Programming and design courses for junior and senior high school students
- Terminal loans

Detailed information about these services is contained in a brochure which can be obtained from our Customer Services Specialist by calling (302) 738-8161. Information about what some of the University's outside users have been doing with PLATO is reported in this section as follows.

Pre-College PLATO Activities

George Gray School

Children from grades four, five and six in the Academically Gifted Program in Area I of the New Castle County School District had an opportunity to work with the PLATO system at their resource center at George Gray School. Approximately 210 children were scheduled each week on the one PLATO terminal available. They were encouraged to explore the variety of lessons available; in a few cases, children were assigned specific math lessons due to difficulties experienced in the regular classroom. Two other kinds of computers were available in the center, but the PLATO system was definitely the favorite.

Howard Careers Center

The Howard Careers Center's Title I Academic Skills Center, under the direction of Mrs. Vicki Gehrt, has been using the PLATO system since July of 1978. Because this program has been so successful, Mrs. Gehrt placed another PLATO terminal in the Instructional Resource Center at Delcastle Vocational School in September of 1980.

Students at both schools are using the Basic Skills Learning System as well as vocational lessons such as the group of lessons available in the package titled "How

to Select and Get a Job." Figure 110 is a display from a lesson that teaches students how to fill out a job application. In this part of the lesson, the student is asked to identify the mistakes made on the application. In addition, gifted and talented students at both schools are using PLATO lessons for educational enrichment and exploration.

New Castle County PLATO Project

The Magnet PLATO Project was funded again for 1980-81 under the Emergency School Aid Act. PLATO has served over 1,300 students in five secondary schools since the beginning of this project in January of 1980. Terminals are located in P. S. du Pont Junior High School, Conrad Junior High School, Ogletown Middle School, Gauger Middle School, and Gunning Bedford Junior High School. Each site has five terminals in its PLATO Learning Center to provide remedial instruction through the Basic Skills Learning System to approximately 60 seventh and eighth grade students each day.

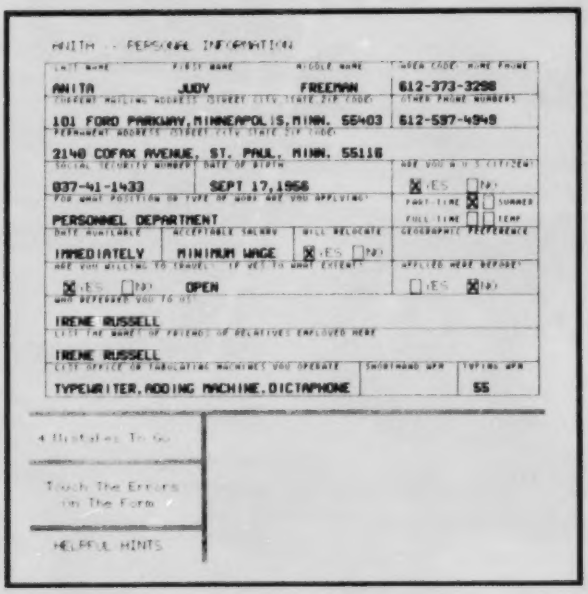


Figure 110. How to Select and Get a Job, by James Vetsch, Karen Newhams, Kenneth Burkhardt, et al. Copyright © 1978 by the Control Data Corporation.

Figure 111 shows a display from a lesson in the Basic Skills Learning System mathematics curriculum, in which students are able to proceed through the material at their own pace. The major objective of the program is to improve student achievement, thereby enhancing student self-concept and fostering more positive interracial interactions.

Five instruments are being used to evaluate the PLATO program: the California Achievement Test, the Self Observation Scales, the Student Intergroup Relations Measures, the PLATO Student Survey, and the PLATO Teacher Ratings. Through these instruments, changes in student achievement, self-concept, intergroup relations, acceptance of the system as a teaching medium, and behavior changes as perceived by classroom teachers are determined and analyzed. Conclusions are then made regarding the program's impact on the district's overall desegregation effort.

Upward Bound

During the summer of 1980, the University's Upward Bound program made individualized instruction via PLATO a regular part of its concentrated on-campus program for academically promising urban high school students. Each student used PLATO in the Smith Hall classroom several times a week for math. A curriculum was designed which presented twenty-seven high school and college level math lessons covering trigonometry, percents, quadratic equations, and simultaneous equations. The curriculum was designed jointly by Upward Bound and OCBI staff, and the Upward Bound instructor learned to monitor his students' progress and subsequently took an active role in implementing this project.

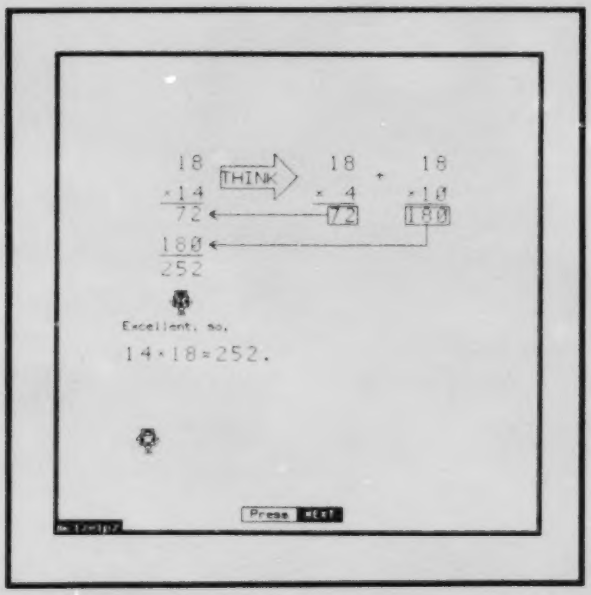


Figure 111. Basic Skills Learning System: Multiplication Skills, Part 7, Cluster 12, Tutorial, by Ralph Heimer. Copyright © 1978, 1979 by the Control Data Education Company.

The objectives set for the PLATO program by Upward Bound's director, William Morris, included:

1. Exposure to computers as a learning tool;
2. Extensive individualized instruction via PLATO;
3. Orientation and training of Upward Bound teacher aides in the capabilities of computers for instruction, record keeping, and motivation.

Student Science Training Program

In January of 1980, the University of Delaware received a grant from the National Science Foundation's Student Science Training Program to have thirty-three gifted high school students come to the University to study math and science. For six weeks the students concentrated on the applications of mathematics to physics, chemistry, genetics, agriculture, chemical engineering, psychology, ecology, physiology and veterinary medicine. The daily schedule consisted of lectures by faculty members, PLATO labs where students interacted with lessons using mathematical models in the various sciences, and a programming seminar where students learned to program mathematical models.

Students chose topics ranging from the "Metastasis of Neoplasms" to "Family Structures in Various Cultures." Working with University faculty, they researched their topic, designed the screen displays, and programmed their projects on the PLATO system. Figure 112 illustrates a student-designed and programmed lesson, "Tiling the Plane." In this lesson the user examines several of the mathematically feasible ways in which regular geometric figures may be put together to cover the plane.

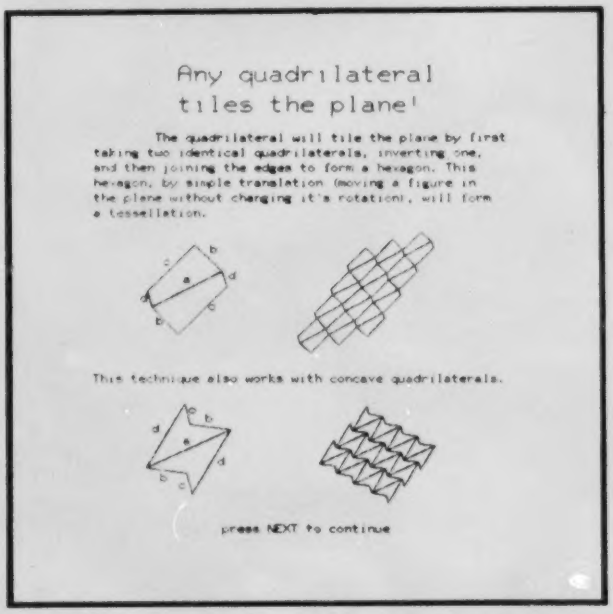

Any quadrilateral
tiles the plane!
The quadrilateral will tile the plane by first taking two identical quadrilaterals, inverting one, and then joining the edges to form a hexagon. This hexagon, by simple translation (moving a figure in the plane without changing it's rotation), will form a tessellation.
This technique also works with concave quadrilaterals.
press NEXT to continue

Figure 112. Tiling the Plane, by Daniel Greenberg. Copyright © 1980 by the University of Delaware.

Pre-College Programming Courses

For the past five years summer programming courses have been held for high school students. During these four-week courses each student plans and programs a lesson in an area of personal interest. Lessons have covered such topics as algebraic equations, units of measurement, and music. Several games have been written, as well as a test grade averager. One high school programmer is working with the mathematics project in developing remedial math programs to be used by college freshmen.

An advanced course has also begun in which students who have completed beginning programming work on projects of their choice with the teacher serving as a consultant.

Class Demonstrations and Public Use

During the 1980-81 academic year, teachers of more than 1,000 pre-college students arranged to have their groups visit the University campus in order to use the PLATO system. In addition to regular elementary and high school classes, there were groups of students from science clubs, special education groups, gifted student programs, and nursery schools. One teacher offered the prize of visiting the PLATO classroom to the class that turned in the most homework assignments.

Many more students used the PLATO system on Friday evenings and on Saturdays, when the Willard Hall PLATO classroom is open to the general public (pre-college students must be accompanied by a parent). It was a common sight to see a parent and child sitting together in front of a terminal playing a math game. A teacher from lower Delaware arranged a 200-mile round trip to bring his gifted and talented students up to the University to use the system one Saturday.

The Du Pont Experimental Station

The Du Pont Experimental Station has made the PLATO system an integral part of a newly developed Technician Training Program. The PLATO system was chosen not only because of its innovative teaching qualities, but also for its PLATO Learning Management (PLM) capabilities. Currently sixteen PLATO terminals connected to the Delaware PLATO system are used by the trainees in this program.

PLM will assist Du Pont in keeping track of trainees as they progress through the program. The Experimental Station Technician Training Program is making use of the University's PLATO consulting services as PLATO lessons and PLM strategies are developed.

The Experimental Station Crafts Training Program is using the PLATO system to manage trainees in six crafts. The management package is being developed for Du Pont by OCBI's Customer Courseware component. Functions of the management package include storing basic information about the trainee (such as source of hire and supervisor's name), tracking trainee progress through the curriculum and recording test scores, keeping trainee attendence records, and scheduling testing and preparing testing notices for both the trainee and the supervisor who will do the testing.

OCBI's Customer Courseware component is currently developing a package for the Crafts Training Group which will allow the trainees to take tests on-line. The testing package will be linked directly to the management package so the scores can be recorded directly.

A single PLATO terminal is currently located in the Crafts Training Office. Future plans call for an additional terminal by July 1, with more terminals as the testing program requires them.

The Du Pont Engineering Design Division

The Process Control Computer Group of the Engineering Design Division is working with OCBI's Customer Courseware Group to put its Software Standards on-line. The process control group develops software which drives a large number of process control computers located in Du Pont and non-Du Pont plants. It has a high turnover of programmers and a strong need for standardization of coding practices. At present it relies on one of the heads of the group and on a printed manual to teach the software standards. By putting the software standards on the PLATO system the group hopes to meet three goals:

1) Teach the standards in a more uniform and effective manner

2) Be able to update the standards easily, since they will be on line.

3) Free the time of the employee who is currently doing the bulk of the teaching.

The Du Pont Engineering Services Division

The Occupational Environmental Control Group is currently working with OCBI to develop a one-hour introduction to its Fundamentals of Industrial Hygiene course. This overview will be used both in plants around the country as preparation for the course and with students taking the Fundamentals course itself. Student response to the one-hour course will be used to evaluate the PLATO system for further use in industrial hygiene training programs.

Federal Aviation Administration

The FAA Academy at Oklahoma City initiated a feasibility study of computer-based instruction in late 1974 with the installation of four terminals on the CERL PLATO system. Initial tests indicated that the PLATO system could provide cost-effective training to FAA employees. In 1978 the University of Delaware started to provide PLATO computing services to the FAA under a General Services Administration contract. At present there are 22 terminals at Oklahoma City and 10 additional terminals at remote sites across the continental United States. The Academy supports a staff of seven in its CBI project.

The first continuous use of the PLATO system in a resident course started in February of 1976 with one lesson in a course called "Flight Inspection Procedures and Techniques." Since that time, additional lessons were written and in 1978 the entire course was converted to use the PLM system and put on-line at seven FAA Flight Inspection Field Offices. The course has been in use ever since and is producing about ten graduates each month. Figure 113 is a display from "RNAV Flight Plan," a lesson which teaches the operation of the area navigation computer in FAA aircraft through simulation of the computer's display panel.

In 1979 a larger study was initiated in the FAA to determine the feasibility of large-scale use of CBI to improve the Agency's training capability. A course in electrical principles was converted to the PLM system and successfully implemented at the

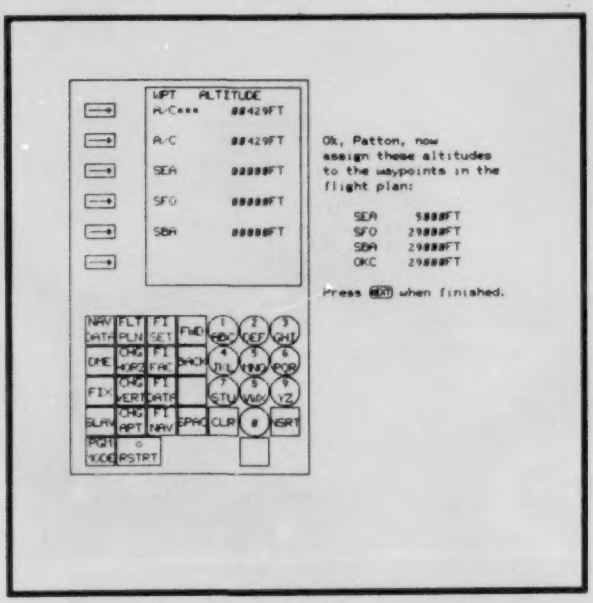


Figure 113. RNAU Flight Plan, by Craig Burson and James Duea. Copyright © 1978 by the FAA Academy.

Academy. In 1980 a staff of technical instructors was assembled to develop or convert 10 FAA courses in electronics and equipment maintenance. The courses will be managed with the PLM system and will utilize videotape, slide-tape, text, PLATO lessons, and electronics laboratory study materials. Figure 114 is taken from a lesson which describes the operation of flip-flops in FAA electronics equipment.

Also during 1980, courses were developed for the sabreliner model 80 pilot refresher, and for powerplant and airframe maintenance. Curriculum development is continuing in several other areas to further study the cost-effectiveness of CBI and to determine the requirements for an agency CBI system. FAA courses to be converted to CBI include flight inspection certification and instrument procedures development.

Delaware PLATO users may inspect the FAA's catalog of instructional lessons called "faacat".

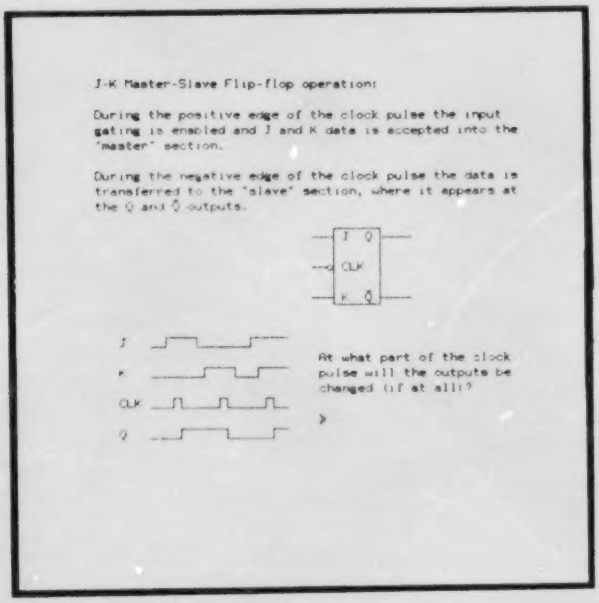

J-K Master-Slave Flip-flop operation:
During the positive edge of the clock pulse the input gating is enabled and J and K data is accepted into the "master" section.
During the negative edge of the clock pulse the data is transferred to the "slave" section, where it appears at the Q and Q̄ outputs.
J Q
CLK
K Q̄
J
K
CLK
Q
At what part of the clock pulse will the outputs be changed (if at all)?

Figure 114. Flip-Flops II, by Craig Burson.
Copyright © 1979 by the FAA Academy.

New Castle County CETA

The New Castle County CETA Learning Center, sponsored by the New Castle County School District, began using the PLATO system in December of 1980. Under the direction of Laura Anderson, CETA's ten terminals are used to deliver lessons in the Basic Skills and General Educational Development Learning Systems to participants in its adult education program. The GED package is designed to help students prepare for and pass the high school equivalency exam. Figure 115 is an example taken from a learning activity in the General Reading curriculum. This activity is taken after the student has completed an inventory test to reinforce learning about implied main ideas.

A CETA staff member is in the process of developing a record-keeping lesson to collect performance data on the 120 program participants.

Figure 115. Identifying the Main Idea When It Is Implied, by Robert Caldwell. Copyright © 1979 by the Control Data Corporation.

The Urban Coalition of Metropolitan Wilmington

In January of 1980, the University of Delaware placed PLATO terminals in three of the eight Urban Coalition Community Centers in Wilmington. The Urban Coalition offers many different kinds of services to minority group members such as basic skills instruction, job placement and counseling. People of all ages go to the community centers that have a PLATO terminal for basic skills training and access to the other program libraries. They are also using the General Education Development package that became available to them last fall.

In September of 1980 the Urban Coalition obtained out-of-school Basic Skills funding from the U. S. Department of Education efforts which enabled two additional PLATO terminals to be placed in two more centers. They are continuing to seek funding to further expand the Urban Coalition PLATO project.

Other Services

In between semesters at the University, a limited number of terminals can be made available to acquaint educational institutions with computer-based education. The typical procedure is for the prospective borrower to make a formal request for the terminal, specifying such things as the duration of the loan (usually one to two months), objectives to be met, target audience, and tentative schedule. A written report outlining the outcome of the special project is due approximately one month after the terminal has been returned.

During the 1981 Winter Session, terminals were loaned to three organizations. Concord High School delivered lessons to general chemistry students as well as to gifted and talented students. Avon Grove High School used its terminal to expose students to the benefits of computer-based education, specifically in mathematics. Through a joint proposal submitted by the Criminal Justice Planning Commission, New Castle County and the City of Wilmington, a terminal was placed in the City/County Building in Wilmington in order to demonstrate the value of computer-based education, specifically applicable to personnel training, and the capabilities of the PLATO system. In May a terminal was placed in the Delaware Correctional Center to acquaint instructors and inmates with PLATO system courseware.

All four projects were very successful; the objectives were met, and participants enjoyed their experiences with the PLATO system.

CHAPTER IV. RESEARCH AND EVALUATION

Because of its developmental nature, the Office of Computer-Based Instruction regularly conducts a rigorous internal evaluation. Student opinions are highly valued and are collected in a systematic manner. Controlled experiments are conducted to test the effectiveness of new lesson materials. Project leaders prepare bi-monthly project reports which are used in monitoring program development throughout the year, and a list of the principal values that CBE has for the University is maintained. The manner in which these components interact is explained in the model for project evaluation.

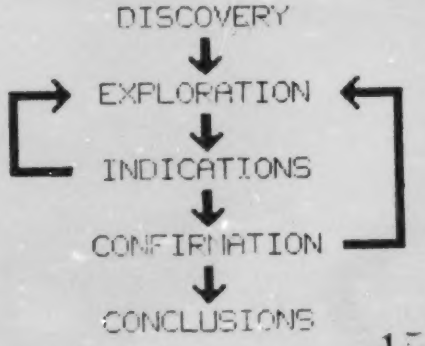
Model for Project Evaluation

At our College of Education's learning symposium on evaluation, Herbert J. Walberg maintained that the process of inquiry contains five main stages, namely, discovery, exploration, indications, confirmation, and conclusions. Every event in the history of CBE at our University fits into one of these categories, both at the overall Office level and within each individual department. At the Office level, PLATO was discovered by our Computer Assisted Instruction Committee during the fall of 1974. The University explored the potential of PLATO during the trial period in the spring of 1975. Indications were summarized in the report of the summer of 1975. Confirmation that PLATO has potential for the University was obtained during the 1975-76 and 1976-77 academic years, based on the successful implementation of PLATO in so many departments. The conclusion that PLATO is a worthwhile long-term activity led to the installation of Delaware's own PLATO system during the 1977-78 academic year.

Each department goes through these stages individually when it begins a CBE project. Discovery usually takes place at one of the periodic demonstrations or through a colleague who personally shows his work to a new person. Exploration consists of reviewing existing lessons, learning about the capabilities of various systems, and reading literature about uses of CBE. This phase is facilitated by the orientation seminar (above, p. 31), the lesson review process, (above, p. 34), and materials in the OCBI library (above, p. 21). Indications are discussed and codified in meetings with peers, OCBI staff members and departmental chairpersons. Confirmation is attained through repeated success of the program in its academic environment. Success is measured through administration of student questionnaires, and through controlled studies of educational effectiveness. A continuous cycle of exploration, indications, and confirmation occurs in most departments, as shown in Figure 116.

Figure 116

Process of Inquiry in Departments Using Computer-Based Instruction



Student Questionnaires

A very important component in the evaluation of the OCBI is the opinion of the students. The instructor of every CBE course is required to have the students complete a questionnaire. Figure 118 shows a standard questionnaire which is given to each instructor as a model for evaluation of PLATO. The instructors can administer the questionnaire as it stands, or they can change, delete, and add items peculiar to their specific courses.

Over the years student response to PLATO has been very positive. Perhaps the two most representative items concerned whether students felt PLATO was an enjoyable learning experience, and whether they felt PLATO was worth the effort. Overall, eighty-nine percent of the students felt PLATO was enjoyable, and eighty-six percent of the students felt it was worth the effort.

Student comments dealt with a variety of topics. They requested more versatility in signing up for time on PLATO, more terminals, and more programs. They asked that lessons developed at other universities be modified to use Delaware terminologies when different terms are used. They want more exercises to practice in preparation for regular hourly exams. They asked that PLATO be used for a greater percentage of their courses. Students commented about PLATO's patience, stating that they were glad that the computer never gets tired of helping them. The most frequent comment concerned the self-paced, individualized learning format. Students feel that PLATO helps them most by providing individualized, immediate feedback to their answers.

Figure 117

STUDENT EVALUATION OF PLATO ®

Course _____ Instructor _____ Date _____

Please answer the following questions about your experiences with the PLATO system and the lessons which you have seen. Your responses will provide valuable information for evaluating and improving PLATO. Thank you for your cooperation.

Indicate your degree of agreement with each of the following statements by marking:

A = Strongly Agree
B = Agree
C = Neutral
D = Disagree
E = Strongly Disagree

1. Using PLATO was an enjoyable learning experience.
2. The mechanics of using the PLATO terminal distracted me from learning.
3. The major points of the lesson were made clear.
4. The lessons on PLATO were too advanced for our level.
5. I learned what the lessons tried to teach.
6. I already knew the material covered in the lessons.
7. Most of the time the work on PLATO was too easy for me.
8. I was frequently frustrated while working on PLATO.
9. The lessons progressed too slowly.
10. The PLATO lessons were unnecessarily picky about the form of the correct answer.
11. The pace of the lessons was too fast.
12. PLATO is an efficient use of the student's time.
13. PLATO is well suited to presenting instructional material in this subject.
14. PLATO gives the student more feedback than other forms of instruction do.
15. The PLATO lessons helped me learn the material more thoroughly than with other forms of instruction.
16. The lessons made allowances for students with different levels of understanding.
17. A lesson on PLATO is more interesting than traditional instruction.
18. I found myself just trying to get through the material rather than trying to learn.
19. In view of the effort I put into it, I was satisfied with what I learned while using PLATO.
20. Too much class time was spent using PLATO.
21. I would like to spend more class time using PLATO.
22. I would like to take another course which uses PLATO.
23. I was able to schedule enough time each week in which to work.

PLEASE SEE OTHER SIDE.

Figure 117 (continued)

24. How many hours have you spent on PLATO in this course? (Mark your answer in the appropriate grid on the first side).

(a) 2 or less (b) 3-5 (c) 6-10 (d) 11-15 (e) 16 or more

25. Have you used PLATO in any other courses? (Mark your answer in the appropriate grid on the first side).

(a) Yes (b) No

26. Have you ever used a computer (other than PLATO) before? (Mark your answer in the appropriate grid on the first side).

(a) Yes (b) No

If so, in what ways is PLATO different from other computers? (Answer below).

27. What have you liked most about PLATO?

28. What have you liked least about PLATO?

29. What aspects of the PLATO classroom (acoustics, lighting, noise level, policies, staff, etc.) were distracting to learning?

30. What aspects of the PLATO classroom were helpful or conducive to learning?

31. What comments, criticism or suggestions do you have for making more effective use of PLATO in this course?

CIRCLe

An important addition to the research component of OCBI was the founding of the Center for Interdisciplinary Research in Computer-Based Learning (CIRCLe). CIRCLe, which is funded by OCBI, has been established as a center within the College of Education to fulfill four primary functions:

1. to help faculty and staff with design and analysis in CBE research projects;
2. to establish an up-to-date database of CBE research materials;
3. to help promote the communication of CBE research ideas and techniques both within the University community and with other universities and research institutions;
4. to assist in the writing of grant proposals in CBE research areas.

CIRCLe is governed by a board of directors consisting of four faculty members from the College of Education and three from other colleges. During 1980-1981 the advisory board was constituted as follows:

Edward Boas, Educational Development
Gerald Culley, Languages and Literature
James Hoffman, Psychology
Fred Hofstetter, Music and Educational Development, Chairperson
C. Julius Meisel, Educational Development
Richard Venezky, Educational Studies
Ronald Wenger, Mathematics

During the past year CIRCLe has provided assistance to departments such as nursing, music, math, the Writing Center, counseling and the library. This has included help with research design as well as statistical analysis of research data. An on-line "Introduction to CBE Research" document is now under preparation.

To build a database of research materials the OCBI library has been reorganized and systematized. An on-line catalog is now available which allows searches for this material through author names, titles, and publishers. This search system will be expanded to include those portions of the ERIC database that pertain to CBE research. A keyword search system is also being developed.

The major event during CIRCLe's first year was a Research Retreat held at the Red Fox Inn in Toughkenamon, Pennsylvania, on February 9, 1981. The following faculty and staff made presentations at this symposium:

Gerald R. Culley, "Successful and Unsuccessful Learning Strategies of Latin Students."

David A. Barlow, "Computer Facilitated Learning in Physical Education."

Paul H. Sammelwitz, "Correlations Between Time Spent on PLATO and Grades Obtained by Students."

Raymond Nichols, "Alternate Instructional Methods in the Teaching of Visual Design."

Ronald Wenger, "Instructional and Research Design Plans for the Mathematical Sciences Teaching and Learning Center."

Richard B. Herr, "CACTUS: Computer Assisted Classroom Teaching of Undergraduate Science."

Victor R. Martuza, "The Use of PLATO Lessons to Collect Data for Multidimensional Scaling."

Fred T. Hofstetter, "Computer-Based Recognition of Perceptual Patterns in Music Dictation Exercises."

Richard Sharf, "Career Exploration."

James E. Hoffman and Leslie C. Skeen, "A Computer-Based Laboratory in Perception and Sensory Neurophysiology."

S. Farnham-Diggory, "Cognitive Growth Parameters of Basic School Tasks."

C. Julius Meisel and George A. Smith, "Recall Patterns Among Mentally Retarded and Autistic Students."

In addition, Dr. Eric McWilliams of the National Science Foundation presented a paper on "Computer-Based Experimentation Into Computer-Based Problem Solving." Dr. Larry Travis, Associate Provost for Computing, concluded the presentations by responding to the day's events. The Retreat was very well received and promises to become an annual event.

CIRCLe has also sponsored visits by CBE researchers from other campuses. Dr. Jean Bamberger from the MIT LOGO Project spoke to the OCBI faculty staff on her work with LOGO. Dr. Alfred Bork of the University of California at Irvine spent two days sharing his considerable experience through meetings with various members of the faculty and staff, and he presented a faculty colloquium.

A major international conference on CBE research has been funded by the College of Education for next year. It will be held at the Radisson Hotel on June 3 and 4, 1982. Prominent researchers in CBE from around the world have been invited to present papers.

In order to assist faculty and staff in writing grant proposals, CIRCLe has been working closely with the Office of Research and Patents, the Office of Contracts and Grants, and the Office of Research and Evaluation of the College of Education. Publications that list available project funds are reviewed periodically. Information gathered from these sources is available on-line for those interested.

Experimentation

Experimentation in the Office of Computer-Based Instruction has taken five directions. First, faculty members have conducted controlled experiments comparing the use of CBE to more traditional forms of instruction. Second, they have conducted perceptual research, where the computer serves as a multi-faceted stimulus presentation and response recording device. Third, experiments have been conducted into the effects of alternate learning strategies upon student achievement and student attitudes. Fourth, faculty members have used computers to acquire accurate data to be used in research. Fifth, senior staff members have been conducting a systematic examination of the problems involved in the administration and organization of computer-based education. The remainder of this section presents abstracts from articles dealing with student achievement, perceptual research, alternative learning strategies, the development of research tools, and organizational research, respectively.

Student Achievement

Hofstetter, Fred T. 1980. Computer-Based Recognition of Perceptual Patterns in Chord Quality Dictation Exercises. Journal of Research in Music Education, Vol. 28, Number 2, pp. 83-91.

During the 1977-78 academic year an experiment was conducted with eighteen freshman music majors for the dual purpose of measuring student achievement in the GUIDO chord quality program and of determining the overall pattern of student responses to chord quality dictation exercises. A two-part test was developed to measure student achievement on chords in close position and on chords in open position. This test was administered three times: first, at the beginning of the first semester before training began; second, at the end of the first semester after training on chords in close position but before training in open position; third, at the end of the second semester after training on chords in open position. As one would expect, correlated t-test comparisons of scores on these tests showed that significant learning gains occurred on the basis of chords in close position during the first semester and on the basis of chords in open position during the second semester. However, additional significant increases were noted on the basis of chords in open position during the second semester. An important transfer mechanism might exist between training on chords in open and close positions. Analysis of student responses made on the third set of tests led to the identification of five principles of chord-quality confusions. First, there are three main clusters of student responses which were due to the almost exclusive confusion of chords by their inversions. Second, the augmented and diminished chords were almost always confused with each other, and they were rarely confused with major and minor chords. Third, the role of expectations in student perception was demonstrated with regard to the root position diminished chord which was almost always confused with its more common first inversion. Fourth, the major chord in root position was found to be much more difficult to identify than is generally believed. In close position five other chords were easier to hear, and in open position three chords were easier to hear. Fifth, the most difficult chord to hear was shown to be the minor chord in first inversion, which in open position is confused only by inversions, but which in close position is confused with augmented and diminished chords. Given the small sample size used in this study (N=18), independently administered replications of this experiment should seek to determine whether the perceptual patterns found in this sample will also occur in other groups.

Barlow, David A., Markham, Jr., A. Stuart, and Richards, James G. 1979. PLATO Facilitation of Precision Motor Analysis in Biomechanics. Proceedings, ADCIS Conference, San Diego, California, February 27-March 1, pp. 1005-1012.

Programmed Logic for Automatic Teaching Operations (PLATO) was developed at the University of Illinois in the 1960's. PLATO was designed to provide computer-assisted instruction (CAI) in teaching a variety of subject matters on many campuses. Recognized as one of the leading systems of teaching by computer, PLATO has the capability of individually instructing several hundred students at one time while carrying on two-way communications. This system enables the student to receive visual information in words, figures, graphs, pictures, and sounds. PLATO is therefore concerned with on-line use of computers by students to further individual learning, by teachers to supervise instruction, by programmers to prepare instructional material, and by researchers to study the optimization of learning.

The purpose of this investigation was to explore a single additional application for PLATO in the realm of undergraduate research projects conducted in the sport science of biomechanics. More specifically, an effort was made to determine the feasibility and value of utilizing PLATO in the precision motion analysis (quantification) of high speed cinematographical data. Parameters measured included: 1. Time required to conduct a complete analysis; 2. Accuracy/quality of film data reduction; and 3. Knowledge or understanding of biomechanical principles affecting human movement.

All undergraduate students (N=92) in Biomechanics at the University of Delaware during 1977 and 1978 were randomly assigned to two research project groups. A control group performed all mechanical calculations without the aid of an on-line computer system. An experimental group was assigned to the PLATO system in order to use appropriate software developed by the investigators for motion analysis of film data. Both groups were required to complete the exact same specific objectives for this research project.

A 16 mm Locam Camera operating at 100 frames/second was used to photograph all students in the performance of a selected sport skill technique. Appropriate cinematographical techniques and procedures were followed to enable the quantified assessment of selected kinematic factors of human performance. Initial film measurements including coordinates of 19 segmental end points of the human body were acquired with the utilization of various manual and automatic digitizers. The PLATO terminals were then used to determine the specific measurement of centers of gravity, joint angles, velocities and accelerations.

In order to compare selected variables measured for the control and experimental groups, a multivariate analysis of variance (MANOVA) was conducted at the conclusion of all projects. Significant F-ratios were obtained for all comparisons.

Within the limitations of this investigation, the simplistic application of PLATO using CAI techniques (as compared to longhand manual procedures) resulted in the following measurable benefits: 1. Considerable decrease in overall data reduction time; 2. Increased accuracy of data reduction; 3. Tremendous increase in quantity of quantified film data; and 4. Increased excitement in the conduct and understanding of biomechanical research. PLATO facilitation techniques obviously enhanced the quality of all research projects involving film analysis of human movement in biomechanics.

Culley, Gerald R. 1979. Computer-Assisted Instruction and Latin: Beyond Flashcards. Classical World, Vol. 72, No. 7, pp. 393-401.

CAI in languages has usually been limited to rigid drills in vocabulary or forms. This article uses two Latin verb lessons developed by the author to show how computer instruction can be made much more versatile and powerful. Routines which conjugate the verb permit a diagnostic lesson to analyze student-typed Latin verbs and localize errors to stem, tense/mood sign or personal ending, providing corrective comments as appropriate; to determine when a student has typed some genuine -- but incorrect -- verb form; and to lead a confused student through a series of grammatical questions about a given item to the correct answer. A companion lesson which gives practice in generating or recognizing verb forms in a gaming format can be tailored in content and difficulty by the student. Thus students may use the same lesson throughout the school year, increasing the number of conjugations, tenses, etc. in use so as to maintain interest and challenge. Finally, the lessons are capable of collecting data on student error patterns which can provide the basis for improved classroom instruction.

Hofstetter, Fred T. 1975. GUIDO: An Interactive Computer-Based System for Improvement of Instruction and Research in Ear-Training. Journal of Computer-Based Instruction, Vol. 1, No. 4, pp. 100-106.

The University of Delaware has established a center for computational musicology for improvement of instruction in music courses and investigation of the nature of musical skills. During its first year the center has developed an interactive computing system (named GUIDO for Graded Units for Interactive Dictation Operations) for recording student learning patterns in ear-training courses. Learning stations consist of a graphics terminal with keyboard, which is used for displaying musical notation and recording student responses, and a synthesizer through which the computer generates aural stimuli. Interactive learning programs have been written in two modes: 1. drill-and-practice mode, in which students hear dictation exercises and are asked questions about what they hear; and 2. touch-sensitive playing mode, in which students can make up their own ear-training examples, examples which they would otherwise not be able to play. By means of these programs each student receives individualized practice in ear-training, and each student's learning patterns are recorded for further study.

The experiment reported was conducted with a freshman ear-training class to determine GUIDO's impact on student achievement in harmonic dictation. During the first semester, all thirty-three students received the same course of instruction in ear-training, with all drill-and-practice done in the tape laboratory. At the beginning of the second semester, the class was randomly split into two groups; seventeen students were assigned to an experimental GUIDO group which practiced ear-training at the computer terminals, and sixteen students were assigned to a control TAPE group which practiced in the tape laboratory. At the end of the first semester (before the implementation of GUIDO), the mean harmonic dictation scores of the GUIDO and TAPE groups were seventy-seven percent and seventy-six percent, respectively. At the end of the experiment the mean scores were eighty-six percent for the GUIDO group and seventy-five percent for the TAPE group. The results of a t-test applied to the GUIDO and TAPE scores at the end of the experiment indicate that the difference between the two groups is significant at the .05 level.

Perceptual Research

Hoffman, James E., and Nelson, Billie. 1981. The Role of Attentional Resources in Automatic Detection. University of Delaware, Department of Psychology, Research Report No. 8101.

A series of experiments investigated the question of whether automatic detection of visual targets requires the investment of attentional resources. Subjects were required to perform an automatic target detection task in conjunction with three different concurrent visual discriminations. Subjects were only able to increase their accuracy on the concurrent task at the expense of decreasing performance on the automatic task, indicating that automatic detection requires the voluntary investment of a limited resource.

One component of the limited resource required by the automatic detection process is the spatial attention system. When attention was in a "distributed state", automatic targets were able to capture the spatial attention system resulting in decreased performance on the concurrent task (the intrusion effect) and increased acuity for forms occurring near the automatic target. In contrast, when attention was "focused" on a display area removed from the automatic target, the intrusion effect was eliminated and automatic detection accuracy decline.

Automatic detection is a process that requires the use of limited mental resources. Its speed and apparent lack of flexibility reflect the ability of automatic targets to capture a share of those resources which are unused by other concurrent mental activities.

Hofstetter, Fred T. 1981. Computer-Based Recognition of Perceptual Patterns in Rhythmic Dictation Exercises. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 216-225.

During the 1978-79 academic year sixteen freshman music majors participated in an experiment in which student response data was saved as they worked through twenty-four units of rhythmic dictation exercises in the University of Delaware's GUIDO system. Analysis of the student database led to the discovery of perceptual patterns and learning styles common to exercises in both simple and compound meters. First, it was found that basic undotted, nonduplet, nontriplet notes are confused exclusively with themselves and never with dotted notes, duplets, or triplets, and the same exclusive confusion pattern is seen for dotted notes, duplets, and triplets, except that they are also confused with their unmodified basic counterparts. By varying the time signatures used in the experiment it was found that significantly more exercises are correctly answered in simple meter when a four is on the bottom, and the same pattern was found when an eight is on the bottom in compound meter. Randomly varying the pitch of the monotone stimulus between c and c2 had no effect on student achievement. As the level of difficulty increased in the twenty-four units, so also did the average student response time and the number of times students asked for the stimulus to be replayed, whereas the average speed at which students played the stimulus decreased. Students who used high average dictation speeds tended to request fewer repetitions of the stimulus, as did students who used the metronome. However, neither speed of dictation, use of the metronome, nor number of repetitions had a high correlation with student achievement.

Hoffman, James E., and Nelson, Billie. 1980. Spatial Selectivity in Visual Search. University of Delaware, Department of Psychology, Research Report No. 8002 (also Perception and Psychophysics, in press). Portions of these data were presented at the 21st annual meeting of the Psychonomic Society, St. Louis, Missouri, November.

To what extent does successful search for a target letter in a visual display depend on the allocation of attention to the target's spatial position? To investigate this question, we required subjects to discriminate the orientation of a briefly flashed u-shaped form while searching for a target letter. Performance operating characteristics (POC's) were derived by varying the relative amounts of attention subjects were to devote to each task. Extensive trade-offs in performance were observed when the orientation form and target letter occurred in nonadjacent display positions. In contrast, the trade-off was much more restricted when the two targets occurred in adjacent positions. These results suggest that the interference between simultaneous visual discriminations depends critically on their separation in visual space. Both visual search and form discrimination require a common limited capacity visual resource.

Hoffman, James, and Laubach, Mark. 1980. Examination of a PLATO-Based Psychology Research Laboratory for Visual Perception. Proceedings, ADCIS Conference, Washington, D.C., March 31-April 3, pp. 232-234.

The conduct of experiments investigating perceptual and attentional processes in human subjects requires a computer system with two characteristics. First, precise timing of visual displays and human responses demands a dedicated microprocessor. Second, the quantity and complexity of the resulting database require the facilities of a large time-sharing system. The PLATO IV system with the PLATO V microprocessor-based terminal provides both of these elements. Software was developed which allowed effective communications between the terminal and the mainframe. This system proved to be an ideal tool for the study of human perceptual and attentional processes.

Hoffman, James E., Nelson, Billie, and Laubach, Mark. 1980.
Controlled and Automatic Detection. Office of Naval Research Report No. 8001.

The secondary task methodology was used to measure the resource demands of controlled and automatic detection. Subjects were required to perform a secondary task of locating a flickering light together with a primary task of visual letter detection. Secondary task performance was lower when combined with the search task than in corresponding single channel control conditions. In addition, this decrement was approximately the same for both controlled and automatic detection. Similarly, both controlled and automatic detection latencies were increased in the presence of the secondary task and by the same amount. Controlled and automatic detections evidently share common resource demanding components.

Hoffman, James E., Nelson, Billie, and Laubach, Mark. 1979. A Dual Task Analysis of Controlled and Automatic Detection. Presented at the 20th annual meeting of the Psychonomic Society, Phoenix, Arizona.

Extensive practice in looking for the same set of targets in a visual search task eventually results in the task becoming "automatic," i.e., search time is independent of the number of characters in both the target set and visual display. In contrast, when the target and distractor characters periodically change roles, subjects use a "controlled" search in which each element of the visual display is compared to the target set in a serial fashion.

The goal of the present research was to measure the attention demands of controlled and automatic search by pairing a primary search task with a secondary task of detecting which of several points of light located next to each display letter was briefly extinguished (flicker task). Results indicated that neither of the two tasks were performed together as well as they could be performed separately. There were two components to the loss in flicker location accuracy that occurred when it was paired with visual search. The largest component was independent of the processing load of the search task and whether search was in controlled or automatic mode. The second, smaller component did reflect processing load, even in the case of automatic detection. Continued training in the automatic detection task eventually eliminated the dependence of secondary task accuracy on search load.

These two components are presumed to reflect two different sources of interference in the dual task situation. The first component reflects competition between tasks in encoding information into short-term memory. Evidently, even highly practiced and presumably automatic tasks require this processing resource. The second component reflects preparation and rehearsal carried out prior to onset of the visual display. Extensive training can eliminate the need for active rehearsal of the target set.

Tobin, Aileen W., and Venezky, Richard L. 1979. The Effect of Orthographic Structure on Letter Search: An Attempt to Replicate and Extend Previous Findings. Presented at the Annual Meeting of the American Educational Research Association, San Francisco, California, April 8.

This study attempted (a) to compare the relative effects of experimental design and orthographic structure on the speed of letter search and (b) to determine the psychological reality of the differences in the structure of the four types of letter strings presented in the search displays, based on a rating procedure similar to that described by Underwood and Schulz. Replicating the results of previous research, differences in orthographic structure had no effect ($p \geqslant .05$) on the mean rate of search when a between-subjects design was adopted, but a significant effect ($p \leqslant .01$) when the paradigm was expanded to permit a within-subject analysis of the data. However, all post hoc comparisons of the mean subjective ratings were highly significant ($p \leqslant .01$), suggesting that subjects can clearly distinguish between strings of letters having different amounts of local orthographic structure.

Hofstetter, Fred T. 1978. Computer-Based Recognition of Perceptual Patterns in Harmonic Dictation Exercises. Journal of Research in Music Education, Vol. 26, pp. 111-119.

During the 1975-76 academic year, student response data was saved for a group of seventeen freshman music majors as they worked through fifteen units of harmonic dictation exercises delivered on the University of Delaware's GUIDO system. Analysis of the student database led to the identification of seven confusion tendencies that affect the perception of harmonies: bass line confusions, confusions of inversion, confusions of chord function, confusions of chord quality, unperceived sevenths, unperceived roots, and favorite response confusions. The level of student achievement on individual harmonies was found to be highly correlated with the percentage of times these harmonies were asked in the curriculum.

Mahler, William A., and Sharf, Richard S. 1977. CAREERS: A Computer-Based Career Guidance System. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 21-24.

This paper reports on a new system which has two major parts. The first part is a computerized version of John Holland's inventory of interests and self-determined competencies, which is called The Self-Directed Search (1974). The individual's responses to the 228 items of this inventory determine the sequence in which various occupations are presented in the second part of the system. The person is able to request and receive various kinds of information about each occupation as it is presented.

This project differs from other computerized guidance projects in several ways: First of all, it was developed at relatively little expense, aided by a small internal grant from the Division of Continuing Education at the University of Delaware. Secondly, it begins with an assessment of the individual's interests and abilities using a well validated inventory, rather than simply having the person explore a large database of job information without any direction. Another difference is that the database is designed to include occupations of interest to college students and adults who might be returning for further education. Access to and use of the system is simple so that people who have never used a computer terminal can use the system. Finally, in addition to providing career guidance services, the system is used to develop a database of information on how people make career choices.

Alternative Learning Strategies

Culley, Gerald R. 1981. Learning How They Learn: Computer Analysis of Latin Students' Errors. Spring meeting of the Classical Association of the Atlantic States, Newark, Delaware, May 1-2.

The high attrition rate in elementary language study reveals an urgent need for analysis of the language learning process. If areas of difficulty can be identified, corrective strategies can be devised. To this end the Delaware PLATO Latin Curriculum has been used to collect data on student errors and to construct confusion matrices. One concerned verb forms; a second, noun-adjective phrases; and a third, parts of speech. The verb matrix indicated that students frequently confused present and future forms, especially the third person plural, though all persons showed this

difficulty. The noun-adjective matrix reveals several problem areas, especially the confusion of nominative plurals with nominative singulars. Where parts of speech are concerned, it is noteworthy that students often mistake pronouns for adjectives, but rarely the reverse. Figures from a lesson in which students about to translate a Latin sentence may ask four things (grammatical form, dictionary entry, dictionary meaning, or function in context) about any words they like, revealed a distressing preference (nearly 50%) for just asking for the English meaning. This suggests a need for better instruction in how to approach a Latin sentence. All of the figures, since they reflect just five months of use, must be seen as preliminary. Another year of data collection will be needed, and further refinement of the process is desirable.

Culley, Gerald R. 1980. Individualized Latin at Delaware: A Progress Report. Proceedings, the Second National Conference on Individualized Instruction in Foreig Languages, Ohio State University, Columbus, Ohio, October 24-25, pp. 75-79.

An experimental individualized course in first-year Latin, offered in the 1980-81 school year at the University of Delaware for up to six credits, uses computerized Latin lessons, in conjunction with a conventional textbook and workbook, as self-study materials. Students meet with the instructor only for counseling and testing. Tests are printed by the computer, which selects items from a stored bank of questions in order to create a unique test at each of twelve levels for each student. Students may set up appointments with the instructor using the computer's message-storing capability. They may learn their class standing by consulting an on-line gradebook.

This approach meets four perceived needs of an individualized program. First, the need for monitoring of student skill development and prompt correction of mistakes is met by the error-analysis routines built into the computerized Latin lessons. Second, tests of sufficient variety and comparability can be produced without unreasonable expense of time on the part of the instructor or secretarial staff. Third, access to the instructor, for tutoring or counseling, is relatively easy. Fourth, students have some sense of participation (through the on-line gradebook) in an endeavor shared with their peers, even though the class does not meet as a whole.

Use of the computer has made it possible for one instructor to administer the course with no more expenditure of time than that required for a conventional section, and without the auxiliary facilities or personnel required by similar programs elsewhere.

Mulford, George W. 1980. Who Needs Computers? Proceedings, the Second National Conference on Individualized Instruction in Foreign Languages, Ohio State University, Columbus, Ohio, October 24-25, pp. 193-199.

The use of computers in education is expensive, and in light of the fact that courseware becomes obsolete, large investments of money in computer terminals and of time in developing computerized materials may seem foolish. The computer can, however, be used effectively to cut costs when used as a bookkeeping tool in programs of individualized instruction. As a teaching medium, the computer may offer benefits in terms of student motivation that outweigh its costs. It can greatly enhance the value of the language laboratory. And if proper care is taken in lesson design, costs can be held within reason and the risk of developing elaborate programs that are subsequently abandoned can be minimized.

Methods of computerized test-making and analysis of test results are presented. The functioning of a computerized language lab is described, and the practicality of various equipment choices discussed. Strategies are outlined for the production of non-text-dependent courseware taking full advantage of the computerized medium.

Nichols, Raymond D. 1980. A PLATOnic Dialog. Print, Vol. 34, No. 6, pp. 64-69.

Traditional modes of instruction can make it difficult for students in visual design classes to separate design concepts from techniques. Lack of technical skills on the part of the students is a hindrance to their gaining visual expertise.

To help alleviate this situation, a series of lessons has been designed for the PLATO computer system at the University of Delaware to help remove the need for technical skills from the thinking processes, permitting students to concentrate on conceptual development. These lessons help prevent students from adjusting their aesthetic criteria to more closely match their own capabilities. Also, the instructor is able to present more effective criticism of student abilities.

Two types of lessons from the advertising design curriculum are shown. The first enables the students to adjust the spacing between letters presented in any one of five typefaces. Students using this lesson have shown marked improvement in their own handling of type and a stronger concern for the development of attitudes involving the aesthetics of optical letterspacing. The other lesson aids students in the design of institutional logos. It was conceived to provide an easily manageable format for the rendering of the students' ideas for symbols. By reducing technical effort to a minimum, it is instrumental in encouraging students to refine their visual thinking to a degree that would be difficult to achieve through the manual manipulation of pencil and paper or ink and compass.

Culley, Gerald R. 1980. When PLATO Knows Latin: Benefits of Letting the Computer Inflect the Forms. Proceedings, ADCIS Conference, Washinton, D.C., March 31-April 3, pp.237-240.

The Delaware PLATO Latin Curriculum, now near completion after three years of development, combines the use of drivers with the use of routines to inflect the variable parts of speech. These routines enable the computer to offer an error markup based on the structural elements of the individual words -- "intelligent" markup very similar to that which a human teacher would give. The routines also make possible lessons tailored by the student to fit individual skill levels and content requirements. Variety, efficiency, flexibility, and precision are all enhanced.

Hofstetter, Fred T. 1980. Computer-Based Aural Training: The GUIDO System. Journal of Computer-Based Instruction, Vol. 7, No. 3, pp. 84-92.

A comprehensive overview of the GUIDO system, this article explains how GUIDO is used by students, how the GUIDO curriculum is delivered in a table-driven, competency-based format, how GUIDO is being used to conduct educational research in student learning, how the use of systems like GUIDO are changing the roles of teachers and students, and how new technological advances are extending the scope of computer-based music education. Sample screen displays and operational descriptions are given for the five

main GUIDO programs, namely, intervals, melodies, chord qualities, harmonies, and rhythms. The instructional variables which can be set by instructors are listed and explained, and the way in which the competency-based tables are edited is presented. Research results obtained from studies of student data saved from the harmonies and intervals programs are summarized in order to show how the tables can be used to conduct educational research in student learning patterns and in order to measure the effects computers can have on student learning styles. The article concludes with a discussion of future hardware which will support the teaching of sight-singing as well as ear-training, and which will allow simulation of the sounds of orchestral instruments.

Kent, James W., and Bayalis, Patricia A. 1980. Doubles Play Strategies in Racquetball on PLATO. Proceedings, International Symposium on the Effective Teaching of Racquet Sports, University of Illinois, Champaign, Illinois, June 11-14.

The purpose of this presentation is to introduce PLATO as a teaching tool in assisting students in the acquisition of cognitive skills for successful doubles play in racquetball. Doubles play for the beginner level racquetball players can be a very hazardous activity. The beginning player has not yet learned to control his stroke technique, has not mastered spacial awareness of the stroke space or the location of the other players within the confines of the court. Racquetball instructors on college campuses feel obligated to teach doubles play in their classes, because failure to do so presents a deprivation of knowledge about one aspect of the game. However, it is usually with great trepidation that an instructor allows four poorly skilled, free swinging players onto a court to give them an opportunity to practice the strategy of doubles play. Safety for the players is an important consideration and subsequently much time is given to stroke development and refinement in singles rather than doubles play. To facilitate the learning of doubles play strategies, the use of computer-assisted instruction and the development of appropriate materials would greatly enhance the opportunity for learning while not creating the risk of injury. PLATO (Programmed Logic for Automatic Teaching Operations) is a computer-assisted instructional system that allows for unique individual interaction with the special features of a plasma panel screen. The lesson presented will give a brief introduction to court markings, rules of service order, and strategies of play to be employed by the service side and the receiving side. Conference attendees will be given an opportunity to use the PLATO terminals and to experience the lesson for strategy and other cognitive skills for doubles play in Racquetball.

Morrison, James L. 1980. Project DISCO: A PLATO Learning System in Consumer Economics. Proceedings, ADCIS Conference, Washington, D.C., March 31-April 3, pp. 220-223.

At the University of Delaware, A Distributive Information System in Consumer Economics (Project DISCO) is presently being developed. The overall objective of the project is to have students develop, retain, and apply "informed habits" associated with rational behavior in the market-place. Basic to the consumer learning model being adopted as part of the project is the development of fifteen PLATO lessons presenting basic consumer economic theory in layman's terms. The fifteen lessons are to become part of the Consumer in the Marketplace Series (CMS) and are structured to enable individuals to develop competencies related to efficient consumption.

The CMS series reflects a "life adjustment education approach" to learning how to maximize satisfaction from spending one's income. By focusing upon the process of rational decision-making, individuals are guided through learning experiences which rely upon the use of appropriate sources of product information, which apply a variety of basic consumer economic concepts, and which enable the evaluation of consumer decisions in terms of benefits and consequences to individuals, society, and the environment.

Arenson, Michael. 1979. Computer-Based Ear-Training Instruction for Non-Music Majors. Proceedings, ADCIS Conference, San Diego, California, February 27- March 1, pp. 949-958.

During the Spring Semester of the 1978 academic year, fifty-two students enrolled in a beginning music theory course for non-music majors participated in a study designed to examine the success of a competency-based approach for teaching aural interval identification to non-music majors. During the same time period a parallel study was being undertaken to measure the success of a competency-based format for teaching interval identification to music majors (Hofstetter, 1978). Both studies utilized the Interval Dictation Units of the GUIDO program at the University of Delaware. A comparison of data obtained from the two studies was helpful in identifying problems unique to non-majors in their acquisition of aural-perceptual skills.

In both studies the students proceeded through GUIDO interval units covering ascending intervals. Then they received a pretest which tested their skill at identifying ascending, descending, and harmonic intervals. Half of the students were assigned to an experimental group and proceeded through the interval units covering descending intervals, and harmonic intervals following a competency-based format. The other half of the students became the control group and proceeded through the same interval units following a sequential non-competency based format.

Results of the study involving the music majors revealed that the competency-based approach was superior to the sequential approach for teaching interval dictation skills. However, results of the study involving the non-majors indicated that the two methods of instruction were not significantly different in helping the non-majors develop the interval aural-perceptual skills. Other data kept by the PLATO system revealed that among the twenty-seven students in the experimental group, only one student finished all the interval units required for the course. On the other hand, fifteen out of twenty-five students in the control group finished all the units required.

Recommendations for changing the ear-training lessons in the GUIDO program for non-majors are as follows:

(1) The drills should remain in the sequential format. The students should be given mastery tests which will determine the difficulty level of materials to be covered.

(2) Help units should be included on the PLATO system to provide students with techniques for listening.

(3) More elementary units within each of the ear-training lessons should be included to give students practice developing simple ear skills as preparation for the drill materials presently on the system.

Hofstetter, Fred T. 1979. Evaluation of a Competency-Based Approach to Teaching Aural Interval Identification. Journal of Research in Music Education, Vol. 27, No. 4, pp. 201-213.

During the 1977-78 academic year, two groups of twelve freshman ear-training students were given the exact same course of instruction in ear-training, with all drill-and-practice given by the computer. The only difference was that, for Group A, a set of competencies was defined and entered into the computer, and the students were not allowed to progress from one unit to another until they had obtained the level of competency required for a given unit. The average pre-test score for Group A was seventy-seven percent, and the average pre-test score for Group B was seventy-five percent. Application of a t-test showed that there were no significant differences among the two groups.

At the end of the course, a post-test was administered to both groups. Group A, which was the competency-based group, had achieved an average score of ninety-three percent, whereas Group B, which was the non-competency group, had a significantly lower average score of eighty-three percent. There was no significant difference between the two groups in the amount of time spent practicing intervals. However, the advancement criteria caused the competency-based group to spend less time on the easier units and more time on the more difficult units. Morever, students participating in the competency-based format felt that the computer was helping them to learn more than the students who were in the non-competency-based group.

Nichols, Raymond D. 1979. The PLATO Display In The Teaching Of Optical Letterspacing. Proceedings, ADCIS Conference, San Diego, California, February 27-March pp. 1022-1026.

Education in the visual arts possesses one very great problem in the student's normal course of study: the ratio of the effort required to 'get an idea' or 'make a judgement' and the amount of effort required to put that idea/judgement into practice. It is here that contemporary technology, namely computers and more specifically PLATO, can serve as an educational tool which may potentially become one of the most important changes to visual arts education.

In the graphic and advertising design area of the Department of Art, University of Delaware, we are heavily involved in the teaching of advertising design as visual communication, a subject very dependent on the visual appearance of the printed word. When one designs an advertisement there are two main goals relating to its effectiveness:

1. the recognition by the viewer of the desired objectives of the advertisement, and

2. the actual reading by the viewer of a major portion of the advertisement.

As advertisements are viewed as 'out of context' material in magazines and newspapers (given the reason these publications are normally purchased) it is important that the reading matter be designed as easily readable and aesthetically pleasing as possible.

It is with this readability in mind that correct 'optical letterspacing' becomes a major concern for the designer. Words in headings, subheadings, etc. must be spaced so as to be read easily, trying to avoid the visual division of the individual word into groups of letters smaller than the word itself. Words which break down into small words can create confusion for the viewer, hindering a positive response.

An example: LARGE

Due to the physical form of the letters and the fact that each letter is placed the same distance from each other in this example we, as viewers, begin to perceive the word 'LARGE' as two words, 'L', and 'ARGE', creating confusion in the mind of the reader.

The problem that occurs in the classroom, where the instruction is aimed at heightening the students' awareness of the spacing and teaching them to make the correct judgements, is the amount of time which is necessary to physically execute the work with enough accuracy and weight that a judgement, resulting in a positive educational experience, can be made as to the correctness of the spacing. Simply outlining (which is the quickest method of executing the letters) does not illustrate the weight of the various letters against one another, and the outlining and filling in of the letters can take from 30 to 90 minutes, even in a fairly rough stage. The more accurate the designer wants the spacing, the more exact the execution must be in the preliminary stages.

PLATO, though, provides a format where specific typefaces can be displayed allowing the student to easily execute words of his/her own or of the instructor's choosing.

An example:

This is the form in which PLATO displays the desired word, in this case DIETERS in the typeface Garamond.

This is the finished form of the word after the correct spacing has been completed by the student. The actual execution of the spacing of this particular word by the author required two minutes, thirty-five seconds and a minimal amount of physical effort.

The format of the lesson provides five alphabets for practice (each representing one of the five major families of typefaces). The spacing of the individual letters can be controlled to 1/60th of an inch by moving them either singly or in groups. The instructor can input up to five required words per typeface (these would provide a form for testing and data keeping) and five comparison words. Both the required and comparison words can be spaced by the instructor and stored, with the student able to visually compare his result with that of the instructor's.

Nichols, Raymond D. 1979. PLATO in the Teaching of Foundation Visual Design. Proceedings, ADCIS Conference, San Diego, California, February 27-March 1, pp. 986-990.

Foundation courses in visual design rely on two basic skills on the part of the student in order for the course to provide a positive educational value. These skills are:

1. technical or hand skills necessary to implement and present an idea to some viewer, and

2. conceptual skills necessary to the actual mental task of solving a specific problem.

To provide this educational experience to our students, it becomes necessary to separate these two skills in order to demonstrate the strengths and weaknesses of each and to show the relation of both to the process of design.

Unit design was developed to provide a solution to four distinct problems that occur with beginning students in the foundations courses in visual design:

1. the restriction which is placed on the visual presentation of the student's ideas resulting from the level of the student's basic technical (hand) skills;

2. the final solution having been dictated not by the student's aesthetic tastes but by the fact that it is easier to change one's tastes than it is to change the actual design;

3. the difficulty involved in the instructor's evaluation which is due to the different mixtures of technical and conceptual skills of the students, making it hard to separate the two areas for discussion or criticism; and

4. the difficulty for the instructor in presenting an effective criticism to the student (given that the experiences and tastes which the instructor uses for his evaluation are not the same experiences and tastes that the student uses in receiving and evaluating the criticism) makes a clear understanding between the instructor and the student quite difficult.

The "Unit Design" program provides for the designing of a two-dimensional image (called a 'unit') which can be placed into a 4 by 4 array by rotating, mirroring and/or reversing the positive/negative relationships of each section.

The 'unit' consists of the dot-like elements of the plasma panel, each of which can be on or off, combining to create the desired image. As these dots are in a fixed position, the method for inputing a given image is the same for all students. Having completed the input of the 'unit,' the student then progresses into design mode where this 'unit' is used to create a modular design comprised of a 4 by 4 array of 'units.' In this mode the student can alter the 'unit' by rotating 0, 90, 180, or 270, mirroring from any of those positions, and/or reversing the positive/negative relationship. The modular design is manipulated until the student arrives at what is felt to be the best, or a series of the best, of the available solutions with regard to the student's aesthetic tastes. These designs can then be judged for aesthetic value in relation to other available designs.

Lesson "Unit Design" utilizes a dithering process for the input of the 'unit.' Dithering is a process which takes a video image and analyzes the tonal density of small areas. These densities can then be duplicated on the PLATO screen by turning on various combinations of plasma panel dots.

The lesson provides the following solutions to the previously stated problems:

1. the lesson reduces the technical skill necessary for the execution of the design, to a simple matter of using the dithering process to input the image into the computer, and the editing of this image has been reduced to the adding or subtracting of fixed dots from which the image is made;

2. the actual execution of the final design is handled through a series of judgements on the part of the student and can be carried out by simply touching the computer screen, making any changes necessary to the final form of the design very simple to implement; and

3. students who create images using the "Unit Design" program have utilized the same technical skills so that any evaluation on the part of the instructor will not have to take into consideration the manner (or at least it will be the same for all students) in which the final design was done and can concentrate on the actual aesthetics and design of the piece.

Culley, Gerald R. 1979. Two-Pronged Error Analysis from Computer-Based Instruction in Latin. University of Delaware Symposium on Language and Linguistics.
This paper describes first-stage results from a package of computer lessons on Latin morphology. It deals with two kinds of error analysis: an immediate response to partially correct verb, noun and adjective forms which will guide the student toward the correct answer, and the collection of precise data on errors by type which will lead to improved teaching by both traditional and electronic means.

These features were made possible by the development of logical models of the Latin verb, noun and adjective in computer code, making it possible for the computer to inflect these parts of speech. Since the machine has this capability for synthesis, it of course has the corresponding analytical capability; it can break down a student's typed response into its structural components of stem, tense/mood sign and personal ending for verbs or base and case ending for nouns and adjectives. Thus the machine can localize errors and offer appropriate comments to the student based on which component is faulty. Further checks within that faculty element can be made for specific errors; e.g., substitution of one tense sign for another.

The same feature permits information on student errors to be saved according to its nature: errors in the stem, errors in personal ending, etc. The first year of use with students has begun to reveal points of difficulty in learning these inflected forms. The relative percentages of errors indicate, for example, that the tense/mood sign of the future gives much more trouble in 3rd and 4th conjugative verbs than in others, and that passive personal endings must be introduced with very careful exposition. A second stage of data collection based on these data will permit still more precise conclusions to be reached.

Wilson, James H., and Paden, Elain P. 1978. The Effects of Drill Structure on Learning in Phonetics Lessons. Proceedings, ADCIS Conference, Dallas, Texas, March 1-4, pp.448-456.

This study is undertaken to investigate the advantages and disadvantages of different forms of drills as used in CAI lessons in phonetics transcription. Measurements of student learning, student attitude and time required for completion are considered for drills constructed 1) with and 2) without specific rehearsal of items initially missed.

Time spent by students in exploratory and quiz sections of the lessons is also recorded. Recommendations are made for other similar applications.

Culley, Gerald R. 1978. Beyond Flashcards: Using the Computer's Power. American Philological Association, Vancouver, British Columbia, Canada.

This is an account of one means of bringing the computer's computational power and branching capability to bear on language teaching, thus escaping the wasteful, rigid "flashcard" approach. It is a program duplicating the logic of the regular Latin verb and so capable of locating the error in a student's response as within the stem, tense/ mood sign, or personal ending. Judging by segments also permits several special checks for common errors, such as inappropriate tense signs. This approach

also makes it possible to establish whether the student's incorrect verb belongs anywhere at all in the tense system of the verb demanded of him. A confused student is led through ten to twelve grammatical questions to isolate the source of his error and correct it, with animation effects revealing the correct form segment by segment as he proceeds with its grammatical identification. Completion of an exercise yields a diagnostic readout, e.g., "trouble in the 3rd plural imperfect passive, both moods." The student may then use a companion lesson to practice these areas, specifying the exact grammatical parameters from which the computer may present challenges in a gaming format.

The code is written so as to permit students to work on any part of the year's curriculum with very little more demand upon computer memory than is made by one student in a single exercise, and versions of the lessons tailored (i.e., in vocabulary and order of introduction of the forms) for any textbook can be quickly and easily produced. The computer saves error patterns on which changes in classroom work or in the computer lessons may be based.

Nichols, Raymond D., and Wilson, James H. 1977. The Computer Display as a Medium in the Teaching of Aesthetics in Visual Design. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 22-24, pp.248-255.

Computer graphics have been investigated and improved markedly in recent years, but their application to art education has been largely neglected. In order to facilitate instruction in an introductory course in basic design, programs were developed on the PLATO system to allow computer graphics to serve as a medium for a student activity that had previously been done using traditional media.

This use of the computer for the execution of technical procedures was aimed at three eductional goals: 1. Students, able to revise previous work with minimal effort, are less likely to alter their aesthetic judgment as a result of effort expended than has been the case using traditional media. 2. Students and faculty, no longer influenced by variations in the students' technical abilities, are forced to concentrate on aspects of visual design. 3. Students using the program should be encouraged by it to involve thought processes throughout the experience, rather than to divorce creative thought, execution, and evaluation.

The courseware has been used by sixty University of Delaware freshmen, and preliminary results show that initial goals were achieved. Further, students were able to execute more intricate designs in a shorter time. Finally, students profitted from a greater opportunity for ongoing feedback, both through interaction with their instructor and through viewing of classmates' designs. These factors have combined to emphasize perception of the experience as education rather than simply production.

Weaver, Charles A., and Seiler, Bonnie Anderson. 1977. Computer Assistance in the Social Processes of Learning. Proceedings, ADCIS Winter Conference, Wilmington, Delaware, February 21-24, pp. 26-38.
Computer-assisted instruction has traditionally been associated with individualized instruction. While there is a great need for such instruction there are also dangers associated with it.

Many observers have noted that it is important for students to verbalize what they have learned and to interact directly with teachers and fellow students about materials being studied. Great damage can result when individualized instruction is carried out in a situation in which social interaction is lacking.

Computers can be used effectively to aid the student communication process as well as to individualize instruction. In this paper we discuss various ways in which computers can facilitate student-student interaction and also can direct students to deal with one another's written ideas.

Examples include lessons in which students learn from each other's strategies and moves, work cooperatively to solve a common problem, pose problems for other students to solve, display their work for others to use, and exchange questions and comments about subject matter with teachers. Specific examples are taken from materials developed by the authors as part of the PLATO Elementary Mathematics Project.

Research Tools

Kent, James W., Barlow, David A., and Craig, Robert. 1980. Relationship Between Ball Velocity and Selected Biomechanical Factors for Male and Female Players in the Backhand Kill in Racquetball. Proceedings, International Symposium on the Effective Teaching of Racquet Sports, University of Illinois, Champaign, Illinois, June 11-14.

Little scientific research has been completed in racquetball. Teaching methodology and technique descriptions have been developed through kinesthesis and observation. The purpose of this study was to identify mechanical aspects that enhance performance of backhand kill shot of high level male (4 'A') and female (3 'A') players. High speed cinematographic techniques (100 fps) were used to investigate performance of the backhand kill in determining relationships between ball velocities and selected biomechanical factors. Successful trials (3) were filmed for each performer. Computerized analysis (using the PLATO system) of film data enabled determination of linear displacements, velocities and centers of gravity. Descriptive statistics were used to present relationships among male and female players. Results indicated male and female performers consistently develop ball velocities ranging between 100.2 and 112.8 mph ($\bar{X}$ = 108.3 mph) and 86.4 and 93.9 mph ($\bar{X}$ =89.2mph) respectively. Ball velocities for male backhand were two percent slower than forehand ball velocities. Although mirror imagery of backhand/forehand strokes occurred from greatest height of racquet head in backswing to ball contact, results from a previous study showed that no other similarities of mechanical technique were found to support the thesis of mirror imagery of total forehand and backhand stroke technique. Comparison of the mean values for ball height at point of racquet contact were very similar (males 14.8 in., females 14.6 in.). Stride length for females ($\bar{X}$ = 2.886 ft) was longer than for males ($\bar{X}$ = 2.53 ft). Resultant stride length/height ratio indicated that females

(.55) were striding 21.7% greater than male (.43). Males (11.2 in.) and female (10.3 in.) players were similar in hitting the ball forward of the center of gravity line. Male (1.9 in.) and female (2.1 in.) performers were consistent in hitting the ball in front of a vertical line from their shoulder and somewhat behind the forward edge of the leading foot (-.32 in. males and -.17 in. females). Implications will be presented.

Kline, Loren. 1980. Analysis of the Soccer Throw-In. NSCAA Annual Meeting, Philadelphia, Pennsylvania, January 18.

The throw-in has traditionally been the method of starting play after touch line outs. Many teams are now sporting a player with an exceptionally long throw. This means that the throw-in has changed from a simple restart to a real offensive weapon, especially in the offensive third of the field. Some unorthodox methods such as a forward hand spring on the ball are being legally used to increase the length of the throw. I feel the traditional standing or running approach to the throw is still preferable because of the advantage of being able to see the target area through the entire motion, and to make last second adjustments on direction, height and speed. A hand spring thrower would need to throw to a predetermined spot. The traditional type of throw also permits release from a maximum height which mechanically enables the thrown ball to assume a flatter flight path.

Dr. David Barlow, Director of the Biomechanics Laboratory at the University of Delaware, filmed the throw-in technique of Dave Ferrell using a high speed camera. Several performance trials were filmed from the side, the front, and the back at 100 frames per second. After using the PLATO system as a digitizer, the results of the study were analyzed and conclusions were drawn.

Organizational Research

Hofstetter, Fred T. 1981. Investing in Computer Technology: Criteria and Procedures for System Selection. Proceedings, the National Conference on Technology and Education, Sponsored by the Institute for Educational Leadership of the George Washington University, the Shoreham Hotel, Washington, D.C., January 6, pp. 45-53.

Matching needs with available technology poses a constant challenge for educational decision-makers. Seven years ago the University of Delaware began what has become a major institutional effort aimed at determining to what extent the needs of higher education can be met by computer-based educational techniques. Essential to the success of this effort was the identification of what available computer-based educational system offered the most capability. As the result of a careful assessment of the characteristics which that system should have and a nationwide search involving both visits to existing computer-based educational projects and consultation with experts in the field, the PLATO system was selected.

Since 1974 the University of Delaware has made a considerable investment in its PLATO capabilities, having installed its own central system in 1978, and having since upgraded it on an annual basis to meet the needs of its growing user community. Over one hundred faculty members are developing computer-based learning materials in thirty subject areas and testing them with students using the two hundred terminals connected to the Delaware PLATO system. The progress made toward determining the extent to which PLATO can meet the needs of higher education at Delaware is described in the Fifth Summative Report of the Delaware PLATO Project which concludes with an eleven-part classification of the benefits of computing in higher education (Hofstetter, 1980).

It was well known in 1974 that rapid changes were occurring in the computer field, and it would appear on the surface that the University took a substantial risk in investing in a large central system like PLATO. Indeed, recognized authorities publicly stated in the mid-1970's that PLATO was a dinosaur that would never make it into the 1980's. Just the opposite has happened; PLATO has emerged in the 1980's in a new microcomputer format which combines the power, communications, and record-keeping features of a central system with the microcomputer's ability to run off-line, to acquire real-time scientific data, and to interface with new microprocessor-based peripheral devices like videodiscs. Through comparative study of the capabilities of available educational computers and through careful analysis of trends in microelectronics and of vendor commitments to making use of microelectronic advances, the decision to install PLATO at Delaware was not as risky as it may have seemed. It is the purpose of this paper to present the system selection criteria used at Delaware and to describe the procedures followed in making a selection based on those criteria.

Hofstetter, Fred T. 1981. Synopsis of the University of Delaware's Office of Computer-Based Instruction. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 5-11.

An overview of the University of Delaware's Office of Computer-Based Instruction is provided. Background information includes a discussion of its origins, the growth of its PLATO network, grants received, research projects underway, and its philosophy about educational computing in the 1980's. An organizational chart is presented and explained showing operations, outside user services, research, and program development components. A list of the overall objectives of the OCBI concludes the article, with references to the overall educational goals of the University where appropriate.

Garton, Roland and Silver, John. 1981. Approaches to Converting PLATO Courseware to Computer-Based Instruction. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 162-166.

It was the purpose of this study to determine how easily a sophisticated PLATO lesson could be converted to run on a MicroPLATO system. If PLATO lessons could be converted to run as well on local microprocessors with floppy disk drives as they do on a mainframe system, the system load would be decreased and it would be shown that

conversion of other large PLATO lessons to MicroPLATO is feasible. The conversion was made on two GUIDO lessons, Intervals and Harmony, which are among the largest in use of memory and central processing on the PLATO system. The practicality of the conversion process has been shown. It took approximately 500 hours to convert these two lessons. That was about half of the original programming time. It is estimated that 30 to 35 percent of the code had to be changed. In the conversion process approaches to converting lessons were developed, and many differences between the mainframe and micro systems were dealt with, including differences in the programming languages they use. The MicroPLATO versions of these lessons are functional equivalents of the originals, which has many implications for the future of PLATO in computer-based education.

Seiler, Bonnie A. 1981. Applying a Systematic Approach to CBE Development in an Academic Environment. Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 305-310.

The Office of Computer-Based Instruction at the University of Delaware assists faculty members in developing courseware for the PLATO system. Faculty members, working with professional programmer/coordinators and student programmers, follow a procedure that consists of four stages -- proposal, design, programming, and dissemination -- each of which involves review/feedback loops. This paper describes Delaware's model for courseware development as well as the roles of each team member, OCBI's training seminars in programming and design, a systems approach to courseware development that emphasizes outside advisors at each stage, and the periodic design and programming reviews of a lesson as it is developed.

Weissman, Jessica and Molad, Clarisse. 1981. Guidelines for Contracting an Outside CBE Development Vendor, Proceedings, ADCIS Conference, Atlanta, Georgia, March 2-5, pp. 318-321.

This paper offers guidelines for computer-based education (CBE) users for contracting outside vendors to do courseware development. The procedures described are designed to help both client and vendor produce quality courseware that meets the client's instructional needs in a cost-effective way. Important features of the development process include the appointment of individuals to represent to client and vendor groups during development, systematic development of materials including review by the client at each stage, and a defined period for field testing and revision. Documentation throughout the process not only forms a record of the project, but serves as a written delineation of the responsibilities of both parties involved in the development effort.

Overall Educational Value of Computer-Based Instruction for the University of Delaware

As the OCBI has grown from the installation of its first terminal on March 14, 1975 to the purchase of its own PLATO system, and as the number of departments using computer-based instruction has increased from the original three to the present thirty-six, the faculty and students have identified many benefits of CBE to the University of Delaware. It is through the realizaton of these benefits that CBE has received widespread support and acceptance at the University. This report concludes with the classifcation of these benefits according to eleven main purposes which are enumerated and explained as follows:

1. To individualize instruction. Faculty members and students often complain that the level of instruction is never right for all members in a class. Some are fast learners; others are slow learners. Some drop out because a course is too boring; others drop out because they can't keep up. The individualized, self-paced approach of CBE has proven to be a remedy for this problem of individual differences.

2. To expand the University's educational market. The market needs a delivery system which can economically deliver instruction over a wide geographical area. Through computer-based techniques, the University can reach more students. For example, if three people in Georgetown wanted to learn Persian, PLATO could teach them whereas a regular course would be cancelled because of small enrollment. This aspect becomes even more important as the learner population is becoming more adult in its make-up.

3. To reduce the time needed for instruction. Computer-based, self-paced techniques make it possible for students to finish courses in less than the normal fourteen-week semester. Students could complete their degrees ahead of schedule, thereby reducing the cost of instruction to the parent and the taxpayer.

4. To emphasize the intrinsic joy of learning and deemphasize competition with peers as a motivating force. In the computer-based environment the anxieties associated with the traditional classroom are minimized. The student is free to respond as he wishes without fear of ridicule from either his peers or his teacher. In such an environment learning is a lot of fun, and motivation is high.

5. To enable students to develop a richer intuitive grasp of complex phenomena through graphic visual representation. Especially applicable to PLATO is the saying that "A picture is worth a thousand words." The ability of PLATO to create interactively a display suited to the student's specific learning needs cannot be overestimated.

6. To provide students with access to a wide range of data for checking out hypotheses. A good example of this benefit is the population dynamics program. Stored in the computer are up-to-date data on the populations of countries throughout the world. The student is able to set variables which affect the futures of those populations, such as time and extent of famines and can then see the effects of those variables upon future generations of the populations.

7. To enable students to learn more of the complexities of phenomena through modeling and simulation. In addition to giving students drill-and-practice and tutorials on various sujects, computers can also allow the student to create models and to simulate complex phenomena. For example, the student can make electronic circuits, design clothes, compose music, draw pictures, mix chemicals, breed fruit flies, and then study the results of the models and simulations. Such flexibility is not a regular part of education in university courses; it should be.

8. To encourage students to tailor their learning experiences to meet their own objectives. How often do students complain that they did not get what they wanted out of a course? They may have met the instructor's objectives, but they did not meet their own objectives. Computers can help them do both. For example, in the University's advanced music theory courses, very little time is spent on set theory. However, some students want to explore it in depth. It is a complex analytical system which cannot be learned by the average student by reading a book. Interactive instruction in this area is made available to the students who want it by means of PLATO's set theory program. There are ten hours of of instruction available for students who want to learn set theory, including periodic tests which assure the students that they are mastering the material. In this way, students are encourged to extend their learning beyond the requirements of the course.

9. To give immediate feedback. One of the greatest advantages of computer-based techniques is immediate feedback. Through individual interaction with the computer, the students partake in a dialogue in which they receive instantaneous responses to their input. There is no other medium which provides this interaction, a benefit which has led to the documentation of significant improvement of instruction in such diverse areas as anesthesiology, French, music, mechanics, dentistry, sociology, calculus, geography, ecology, health, physics, and accounting.

10. To provide students with an anonymous way of asking questions about sensitive matters. Recent research has shown that the use of anonymous sign-ons whereby students can use PLATO without revealing their identities has encouraged students to ask questions and get responses on sensitive issues which they would normally be afraid to discuss. PLATO's group notesfile capabilities enable students not only to ask questions and to get responses on their own personal questions, but also to see the questions and responses anonymously written by other students. Especially in the area of sex education this has proven to be an excellent means of allowing students to anonymously explore sensitive personal issues.

11. To provide maximum flexibility. Microelectronic technology has progressed to the point at which practically any electronic device can be connected to a computer terminal. The terminal already has a slide projector, a touch-sensitive screen, a random-access audio device, a speech synthesizer, and a music generator. The terminal also contains a micro-processor, the latest development in computer hardware, which secures product flexibility for the foreseeable future.

APPENDIX

Catalog of Programs under Development in the Office of Computer-Based Instruction

CATALOG OF PROGRAMS UNDER DEVELOPMENT IN THE OFFICE OF COMPUTER-BASED INSTRUCTION

Instructional Lessons

-- ACCOUNTING --

Title	Filename	Developer	Programmer
Accounting Sample Test	acc207t	A. DiAntonio	L. Bizoe W. Childs C. Leefeldt K. Slaughter
Costing Methods	costing	J. Gillespie	W. Childs
The Balance Sheet Equation	bsheet	A. DiAntonio	G. Betz K. Slaughter
What Is Break-Even Point?	brkeven*	A. DiAntonio	L. Bizoe

-- ACCOUNTING: PLM --

Title	Filename	Developer	Programmer
Advanced Accounting	acc415	A. DiAntonio	C. Leefeldt
CMA Review	accumacu	A. DiAntonio	A. DiAntonio
CPA Review	cpareview	A. DiAntonio	A. DiAntonio
Financial Accounting	acc207cu	A. DiAntonio	C. Leefeldt
Intermediate Accounting	acc316cu	A. DiAntonio	C. Leefeldt
Managerial Accounting	acc208cu	A. DiAntonio	C. Leefeldt

*Programs marked with an asterisk(*) have been submitted to Control Data Corporation for publication.

-- AGRICULTURE --

Title	Filename	Developer	Programmer
APS101: Sample Test Questions	apsintro	Sammelwitz	Sammelwitz
Anatomy and Physiology on PLATO	agplato	Sammelwitz	D. Anderer
The Endocrine System: Overview	endocrine	Sammelwitz	D. Tripp S. Waeber M. Porter
Terminology & Definitions	endocrine1	Sammelwitz	D. Tripp S. Waeber M. Porter
Listing ~~&~~ Classifications of Endocrine Structures	endocrine2	Sammelwitz	D. Tripp S. Waeber M. Porter
Locations of Endocrine Structures in Mamalian Species	endocrine3	Sammelwitz	D. Tripp S. Waeber M. Porter
Locations of Endocrine Structures in Avarian Species	endocrine4	Sammelwitz	D. Tripp S. Waeber M. Porter
Hormones Secreted by the Endocrine Structures	endocrine5	Sammelwitz	D. Tripp S. Waeber M. Porter
Genetic Relations	relations	G. Haenlein	C. Lewis D. Tripp

-- AGRICULTURE: PLM --

Title	Filename	Developer	Programmer
Digestion	apsmod4	Sammelwitz	Sammelwitz
Endocrine System	apsmod2	Sammelwitz	Sammelwitz
Life Organization	apsmod1	Sammelwitz	Sammelwitz
Metabolism	apsmod7	Sammelwitz	Sammelwitz
Muscles	apsmod6	Sammelwitz	Sammelwitz
Reproduction	apsmod3	Sammelwitz	Sammelwitz
Respiratory System	apsmod	Sammelwitz	Sammelwitz
Skin and Bones	apsmod5	Sammelwitz	Sammelwitz

-- AGRICULTURAL ECONOMICS --

Title	Filename	Developer	Programmer
Simag: An Agribusiness Simulation	simag	M. Hudson Toensmeyer A. DiAntonio	C. Leefeldt

-- AGRICULTURAL ENGINEERING --

Title	Filename	Developer	Programmer
Beginning Drafting	engdraft	L. Bizoe	L. Bizoe

-- ANTHROPOLOGY --

Title	Filename	Developer	Programmer
The Anthropological Study of Art Style	roel	P. Roe	K. Sims
Anthropological Descent Theory	ndescent	N. Schwartz M. Fortner	C. Collings K. Sims

Anthropology (continued)

Title	Filename	Developer	Programmer
Anthropological Residence Theory	nresiden	N. Schwartz M. Fortner	C. Collings K. Sims
Cellular Structure	physanthro	M. Hamilton	M. Fortner
The Derivational Chain	roe2b	P. Roe	K. Sims
Grammatical Study of Art Styles	roe2a	P. Roe	S. Lamphier

-- ART --

Title	Filename	Developer	Programmer
Aesthetic Value	value	R. Nichols	Joseph Maia
Composition Using Grey Scale Tones	gscale	R. Nichols	Joseph Maia B. Williams
Design Aesthetics and Creation	udesign	R. Nichols	C. Wickham J. Trueblood
Letter Spacing	spacing	R. Nichols	C. Wickham J. Trueblood
Newspaper Copy Fitting	copyfit	R. Nichols	S. Cox
Optical Letterspacing Typeface Editor	nchar	J. Trueblood	J. Trueblood S. Cox B. Williams
Painting on a Computer	mpt	R. Nichols B. Williams	B. Williams
Production of Camera-Ready Mechanicals	markings	R. Nichols	S. Cox B. Williams
Random Dot Pattern Generator	random	R. Nichols	K. Abele
Rotating Squares Generator	square	R. Nichols J. Wilson	J. Wilson
Slide-Tape Presentation Editor	artslide	R. Nichols	J. Trueblood

Art (continued)

Title	Filename	Developer	Programmer
Variable Letterspacing of Body Copy	space	R. Nichols	S. Cox B. Williams

-- BIOLOGY --

Title	Filename	Developer	Programmer
Gene Mapping by Conjugation Analysis	conjug	A. Olsen	A. Olsen
Genetics of Operons	operona operonb operonc	D. Sheppard	K. Bergey B. Cooley
Human Karyotype Analysis	karyo	A. Olsen	A. Olsen
Meiosis	meiofine	J. Beyer A. Olsen	J. Beyer
Mitosis and Cell Division	mitofine	J. Beyer A. Olsen	J. Beyer
Population Genetics	beans	A. Clark	B. Cooley
Positioning Genes in Bacteria by Deletion Mapping	delmap delmapb	D. Sheppard	J. Beyer
Somatic Cell Genetics	somatic somaticb	D. Sheppard	J. Beyer
Temperature Sensitive Morphological Mutant of Drosophila Melanogaster	tsfly	D. Sheppard	K. Bergey

-- CHEMICAL ENGINEERING --

Title	Filename	Developer	Programmer
Chemical Equilibrium Calculation Program	reactul	S. Sandler	J. Davis
Chemical Equilibrium, Problem 1	react1	S. Sandler	J. Davis

Chemical Engineering (continued)

Title	Filename	Developer	Programmer
Chemical Equilibrium, Problem 2	react2	S. Sandler	J. Davis
Corresponding States Principle, Lesson I Introduction to the Compressibility Factor Diagram	states1	S. Sandler	A. Semprebon
Corresponding States Principle, Lesson II Use of the Compressibility Factor Diagram	states2	S. Sandler	A. Semprebon
Corresponding States Principle Lesson III: The Enthalpy Departure Diagram	states3	S. Sandler	A. Semprebon
Desuperheater	desuper	S. Sandler	D. Williams D. Harrell
Dryer-Recycle Mass Balance	massba12	R. Pigford	B. Russell
Expansion of an Ideal Gas	expan	S. Sandler	D. Harrell
Introduction to Mass Balance	massba11	R. Pigford	B. Russell
Mass Balance With Chemical Reactions	mb3	S. Sandler J. Ayres	J. Ayres
Modeling of Binary Mixtures	binmix	S. Sandler D. Harrell	A. Semprebon D. Harrell
Modeling the Draining of a Tank	tank1	S. Sandler	B. Schwarz
The Rankine Refrigeration Cycle	refrig	S. Sandler	A. Semprebon R. Lamb
Repressurizer	repress	S. Sandler	D. Harrell A. Semprebon

Chemical Engineering (continued)

Title	Filename	Developer	Programmer
Steam Turbine	turb	S. Sandler D. Harrell	B. Schwartz D. Harrell
Vapor-Liquid Equilibrium	vliquid	S. Sandler J. Ayers	B. Schwarz

-- CHEMISTRY --

Title	Filename	Developer	Programmer
Applications of Logs: pH	phlogs	B. Russiello	B. Russiello
Determining Shapes of Molecules: VSEPR	vsepr	E. Davis	R. Garton

-- CIVIL ENGINEERING --

Title	Filename	Developer	Programmer
Internal Force	civeng1	J. Snyder Chesson, Jr.	J. Snyder

-- COMPUTER SCIENCE --

Title	Filename	Developer	Programmer
An Introduction to the Computers at the University of Delaware	ccintro	D. O'Grady	D. O'Grady
Push-Down Automata Simulator	pdsim	Weischedel	Joseph Maia
Turing Machine Simulator	tmsim	Weischedel	Joseph Maia

-- COUNSELING --

Title	Filename	Developer	Programmer
Exploring Careers: Introduction	introexp*	R. Sharf	L. Bizoe C. Collings M. Laubach

*Programs marked with an asterisk(*) have been submitted to Control Data Corporation for publication.

Counseling (continued)

Title	Filename	Developer	Programmer
Exploring Careers Part 1	explore1*	R. Sharf	L. Bizoe C. Collings M. Laubach
Exploring Careers Part 2	explore2a*	R. Sharf	L. Bizoe C. Collings M. Laubach
Exploring Careers Part 3	explore3*	R. Sharf	L. Bizoe C. Collings M. Laubach
Exploring Careers Series	expindex	R. Sharf	L. Bizoe C. Collings M. Laubach
Holland's Self-Directed Search and Career Inventory	search1	R. Sharf W. Mahler	W. Mahler M. Laubach
Job Aids	jobroute	R. Sharf	M. Laubach C. Collings
Job Benefits	benefits	R. Sharf	K. Jones
Occupation of Career Code	search7	R. Sharf W. Mahler	W. Mahler M. Laubach
Occupational Information	occinfo*	R. Sharf	L. Bizoe C. Collings M. Laubach
Work Tasks	workexp	R. Sharf	G. Sharnoff

-- ECONOMICS --

Title	Filename	Developer	Programmer
Economic Practice Problems	econprob	J. Miller L. Pienta	K. Slaughter Zembrzuski
Fiscal Policy (adapted from University of Illinois)	paded	D. Paden J. Miller	Zembrzuski

*Programs marked with an asterisk(*) have been submitted to Control Data Corporation for publication.

Economics (continued)

Title	Filename	Developer	Programmer
Income Determination with Government (adapted from University of Illinois)	consum1	D. Paden J. Miller	Zembrzuski
Income Determination without Government (adapted from University of Illinois)	consum	D. Paden J. Miller C. Link	Zembrzuski P. Smith
Quantitative Analysis of Competitive Firm	compete	Zembrzuski J. Miller	Zembrzuski
Review of Graphing	econgraph	K. Mathre J. O'Neill	K. Mathre
Supply and Demand	supply	D. Paden J. Miller C. Link	Zembrzuski P. Smith

-- EDUCATION --

Title	Filename	Developer	Programmer
Big Story	readalong	P. Pelosi	J. Weissman
Factors in Reading Comprehension	readlab	F. Murray	J. Sandler
Fast Accurate Symbol Transcription for Evaluation of Elementary Reading	squiggles	J. Pikulski	D. Braendle
Hang-a-Spy (hangman with spies)	hangspy*	J. Weissman B. Seiler	J. Weissman
Hang-a-Spy Word List Maker	hangsetup*	J. Weissman	J. Weissman

*Programs marked with an asterisk(*) have been submitted to Control Data Corporation for publication.

Education (continued)

Title	Filename	Developer	Programmer
Make a Spy	makespy	J. Weissman	J. Weissman
Metric Estimate Game	skunkwar	B. Seiler J. Wilson	B. Seiler J. Wilson
Sight Word Attack Team	swat	R. Bianco P. Pelosi J. Weissman B. Seiler	J. Weissman
Sight Word Teaching Method Simulations	sightword	P. Pelosi	J. Weissman
Spy Meeting	spymeet	J. Weissman B. Seiler	J. Weissman
Spot the Spy	spotspy	J. Weissman P. Pelosi B. Seiler	J. Weissman
Spy Concentration	newtwo	J. Weissman B. Seiler	J. Weissman
Spy Concentration Word List Maker	consetup	J. Weissman	J. Weissman C. Leefeldt
SWAT Promotion Test	swattest	J. Weissman P. Pelosi	J. Weissman
Word Zoo	wordzoo	S. Hansell	J. Weissman

-- ENGLISH --

Title	Filename	Developer	Programmer
The Animal Game	nanimal	L. Arena S. Homsey	J. Weissman J. Snyder R. Stabosz
Animal Game Editor	animaled	S. Homsey R. Stabosz	R. Stabosz J. Snyder
Computer Poems	udpoems	P. Phelan	R. Stabosz J. Weissman
Diagnostic Test of Classroom English	ndtest	L. Arena M. Peoples S. Homsey	J. Snyder E. Langhans

English (continued)

Title	Filename	Developer	Programmer
Diagnostic Test Editor	ndtedit	M. Peoples J. Trueblood	J. Snyder E. Langhans
IS and ARE, the Missing Links	cdelete	L. Arena M. Peoples	J. Weissman
Jotto	udjotto	S. Homsey	S. Homsey
Learning TO BE	behabit	L. Arena M. Peoples	J. Weissman Jean Maia J. Snyder R. Stabosz
The Power of Negative Thinking	negativ1	L. Arena S. Homsey	J. Weissman R. Stabosz J. Snyder
A Review of English Lessons	reviewt	S. Homsey A. Deveau R. Stabosz	S. Homsey A. Deveau R. Stabosz P. Patton
An S at the End	threepv	L. Arena P. Townsend	Jean Maia

-- HEALTH EDUCATION --

Title	Filename	Developer	Programmer
Contraception Information	contra	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: The Pill	contra2	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: The IUD	contra3	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: The Diaphragm	contra4	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: Foams/DES	contra5	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: The Condom	contra6	Dominguez Jr A. Lomax	Dominguez Jr

Health Education (continued)

Title	Filename	Developer	Programmer
Contraception: Suppositories/ Withdrawal	contra7	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: Sterilization	contra8	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: Rhythm	contra9	Dominguez Jr A. Lomax	Dominguez Jr
Contraception: Douching/Positions/ Other Myths	contra10	Dominguez Jr A. Lomax	Dominguez Jr
Sex Education Referral Network	refer	A. Lomax	M. Laubach D. Tripp
Sex Myth Quiz	myth	Dominguez Jr A. Lomax	Dominguez Jr
Wellspring: What It's All About	wellspri	Dominguez Jr A. Lomax	Dominguez Jr

-- HUMAN RESOURCES --

Title	Filename	Developer	Programmer
Alteration Laboratory	alterlab	D. Elias F. Mayhew F. Smith	D. Anderer D. Elias J. Wilson
Body Measurement	bigbody	D. Elias F. Mayhew	D. Anderer K. Bergey
Consumer Education Resource Network	consume	H. Stewart	M. Laubach D. Mellor K. Bergey D. Tripp D. Anderer
Consumer Education Steps to Problem Solving	cesteps	H. Stewart N. Mc Shaw	K. Bergey
Consumer in the Marketplace: Topic #1 - Consumption	conecon1	J. Morrison D. Mellor	D. Mellor K. Bergey

Human Resources (continued)

Title	Filename	Developer	Programmer
Consumer in the Marketplace: Topic #2 - Information	conecon2	J. Morrison D. Mellor	D. Mellor K. Bergey
Consumer in the Marketplace: Topic #3 - Consumer Purchasing Matrix	conecon3	J. Morrison K. Bergey	K. Bergey D. Mellor
Consumer in the Marketplace: Topic #4 - Consumer Price Index	conecon4	J. Morrison K. Jones	K. Jones K. Bergey
Consumer in the Marketplace: Topic #5 - Sovereignty in the Marketplace	conecon5	J. Morrison K. Jones	K. Jones K. Bergey
Consumer in the Marketplace: Topic #6 - Time-Probability	conecon6	J. Morrison K. Jones	K. Jones K. Bergey
Consumer in the Marketplace: Topic #7 - Opportunity Costs	conecon7	J. Morrison K. Jones	K. Jones K. Bergey
Consumer in the Marketplace: Topic #8 - Investment in Human Capital	conecon8	J. Morrison C. Ford-Kipp	C. Ford-Kipp K. Bergey
Consumer in the Marketplace: Topic #9 - Consumer Rights and Responsibilities	conecon9	J. Morrison C. Ford-Kipp	C. Ford-Kipp K. Bergey
Determining Pattern Alterations	mcd	D. Elias F. Mayhew	D. Anderer D. Elias
Ease Requirements	ease	D. Elias F. Mayhew F. Smith	D. Anderer D. Elias

Human Resources (continued)

Title	Filename	Developer	Programmer
Metric Practice	seemet	D. Elias F. Mayhew F. Smith	D. Anderer D. Elias
Pattern Measurement	patterns	D. Elias F. Mayhew B. Seiler F. Smith	D. Anderer K. Bergey D. Elias J. Wilson
Weight Reduction Regimens	weight	L. Aljadir	P. Patton

-- LANGUAGES --

Title	Filename	Developer	Programmer
Artifex Verborum	artifex	G. Culley	G. Culley
Cursus Honorum: A Latin Verb Game	cursus1	G. Culley	G. Culley
ESPANOL: lengua y cultura de hoy	hoy1	T. Lathrop	B. Pasapane
The French Verb Test	tedtest	T. Braun	G. Mulford
German Adjective Endings	pgerm	A. Howard	A. Howard
Hidden Word Game and Generator	subpuz	C. Brooks	C. Brooks
Language Lab Tape Editor	tapemaker	G. Mulford	J. Wilson
Mare Nostrum: A Game with Latin Nouns and Adjectives	mare	C. Culley	G. Culley
Principal Parts of German Verbs	gquiz	R. Skillman	R. Skillman
Review of English Grammer	udgrammer	G. Culley	G. Culley
Ringers: A Grammar Recognition Lesson	ringers	G. Mulford	G. Mulford

Languages (continued)

Title	Filename	Developer	Programmer
Substitution Drill and Editor	subdrill submaker	D. Williams	D. Williams
Translat: Exercises in Translating Latin Sentences	translat	G. Culley	G. Culley
Touche: A French Word Order Touch Lesson	touche	G. Mulford	G. Mulford
Underliner: A Word-in-Context Lesson	uliner	G. Mulford	G. Mulford
The Verb Factory	factory1	G. Culley	G. Culley

-- MATHEMATICS --

Title	Filename	Developer	Programmer
Calculus Basic Skills	calcprac	M. Brooks	M. Brooks
Calculus Basic Skills I	calcprac1	M. Brooks	M. Brooks
Calculus Basic Skills II	calcprac2	M. Brooks	M. Brooks
Concepts of Functions I - The Black Box	mfunct1	M. Brooks	M. Rogers
Concepts of Functions II - Transforming Graphs	mfunct2	M. Brooks	M. Rogers
Concepts of Functions III - Relations and Functions	mfunct3	M. Brooks	M. Brooks
Concepts of Functions IV - Finding Composite Functions	mfunct4	M. Brooks	M. Brooks
Derivative, Difference Quotients, and Increments	deriv4	A. Stickney	A. Stickney

Mathematics (continued)

Title	Filename	Developer	Programmer
Differentiation Formulas	deriv5	A. Stickney	A. Stickney
Integration Using Areas	integ1	A. Stickney	A. Stickney
Interval Notation Quiz	interval	M. Brooks	M. Brooks
Library of Math Routines	mathrout	M. Brooks	M. Brooks
Math Diagnostic Test	matest	R. Wenger K. Slaughter	K. Slaughter
Math Practice Problem Driver	mpracind grafbase graphcvt	R. Wenger K. Slaughter	K. Slaughter J. Green R. Payne
Parametric Curve Plotter	pplotter	M. Brooks	M. Brooks
PLM Curriculum for Pre-Calculus Mathematics	pcmath	Math Staff	M. Brooks
Polar Coordinate Game	polarco	A. Stickney	A. Stickney
Power Series Plotter	psplotter	M. Brooks	M. Brooks
Properties of Integrals	integ2	A. Stickney	A. Stickney
Rectangular Coordinates	carteco	A. Stickney	A. Stickney
Rootfinder and Function Plotter	rootfind	A. Stickney	A. Stickney
Sequence Plotter	sequence	M. Brooks	M. Brooks
Sigma Notation Quiz	sigma	M. Brooks	M. Brooks
Simulation of TI-58 Calculator	ticalc	A. Stickney	A. Stickney
Solving Literal Equations	liteq	M. Brooks	M. Brooks
Surface Plotter	plot2b	A. Stickney	A. Stickney

Mathematics (continued)

Title	Filename	Developer	Programmer
Two Variable Function Plotter	plot2	A. Stickney	A. Stickney
Vector Field Plotter	vplotter	M. Brooks	M. Brooks

-- MILITARY SCIENCE --

Title	Filename	Developer	Programmer
Solving Problems Statistically	yellow	T. Reinhardt	M. Houghton T. Nayes

-- MUSIC --

Title	Filename	Developer	Programmer
Aural Recognition of Scales and Modes	modes	M. Arenson	R. Kozerski W. Lynch
Pitch Identification Test	cmimus	M. Arenson	W. Lynch
Clef Transposition Test	cmimus2	M. Arenson	R. Kozerski
Grand Staff Test	cmimus3	M. Arenson	R. Kozerski
Scale and Mode Test	cmimus4	M. Arenson	P. Bayalis
Key Signature Test	cmimus5	M. Arenson	P. Bayalis
Four Voice Triad Test	cmimus6	M. Arenson	P. Bayalis
Beat Unit and Division Test	cmimus7	M. Arenson	P. Bayalis W. Lynch
Meter and Time Signature Test	cmimus8	M. Arenson	P. Bayalis W. Lynch
Rhythm Notation Test	cmimus9	M. Arenson	P. Bayalis W. Lynch
Half Steps - Whole Steps	cmimus11	M. Arenson	G. Feurer
Triad Construction Identification	cmimus12	M. Arenson	G. Feurer

Music (continued)

Title	Filename	Developer	Programmer
Transposition	cmimus13	M. Arenson	G. Feurer P. Nelson
Functions in Keys	cmms14c cmms14b	M. Arenson	P. Nelson
Bass Figurization	cmms15c cmms15b	M. Arenson	P. Nelson
Basic Part Writing	cmms16c cmms16b	M. Arenson	P. Nelson
Competency-Based Chord Quality Drill	udchord	Hofstetter	W. Lynch
Competency-Based Harmony Drill	udharmon	Hofstetter	W. Lynch
Competency-Based Interval Drill	musicdrill	Hofstetter	W. Lynch
Competency-Based Melody Drill	udmelody	Hofstetter	W. Lynch
Competency-Based Rhythm Drill	udrhythm	Hofstetter	W. Lynch
Fundamentals of Ear-Training	udthomas	R. Hogenson	R. Thomas
Harmonies with Modulations	modset	Hofstetter	W. Lynch
Harmonic Dictation Drill	har01set	Hofstetter	W. Lynch
Interval Dictation Drill	interunits	Hofstetter	W. Lynch
Interval Hall of Fame	intervals	Hofstetter	W. Lynch
Intervals	bintrain	M. Arenson	R. Thomas
Melodic Dictation Drill	meldset	Hofstetter	W. Lynch
Musical Concentration	udsheppard	J. Sheppard P. Harris	J. Sheppard P. Harris W. Lynch

Music (continued)

Title	Filename	Developer	Programmer
Musical Terms	musterms	M. Arenson	C. Fauntroy W. Lynch
Musical Terms Glossary	cmimusterm	M. Arenson	W. Lynch
MusiMatic	musimatic	W. Lynch	W. Lynch
Note Reading Hall of Fame	notegame	P. McCarthy	D. Braendle
Orchestration for the University of Delaware Sound Synthesizer	box	Hofstetter	W. Lynch
Partials	partial	M. Arenson	A. Gaer
Rhythmic Dictation Drill	rhydset	Hofstetter	W. Lynch
Scale Degree Identification	scalenum	M. Arenson	T. Gardos
Set Names (after Forte)	setnames	Hofstetter	J. Trueblood
Seven Basic Rhythms	rhythm	M. Arenson	R. Preiss W. Lynch
Twentieth Century Melodies	me102dset	Hofstetter	W. Lynch

-- NURSING --

Title	Filename	Developer	Programmer
Abdominal Perineal Resection: A Patient Care Simulation	peri	M. A. Early	M. Fortner
Challenge Exam: N301	chalques	M. A. Early M. Carroll D. Williams Kazmierczak	M. Fortner K. Slaughter
Challenge Exam: N406	chal406x	C. Freed M. A. Early L. Juras	M. Fortner K. Slaughter

Nursing (continued)

Title	Filename	Developer	Programmer
Human Heart Valves (adapted from a University of Illinois veterinary medicine lesson)	heartv2	M. A. Early	C. Criste D. Graper
An Introduction to the Format of the Challenge Exam	introtst	M. Fortner M. A. Early	M. Fortner
Nurse 201 Meds Test	test201	A. Craig	M. Fortner
Nursing Inventory Operations	nopts	M. Laubach D. Mackay A. Start	M. Laubach
The Nursing Process (Adapted from the University of Pittsburgh)	soapie	S. Cudney	C. Wickham J. Trueblood
PLM Test Modules for Psychopharmacalogical Nursing Lesson III	phm3mod1 phm3mod2 phm3mod3	S. Alderson E. Boetcher	E. Stevens
Psychopharmacalogical Nursing, Lesson I: Introduction	npharm1	S. Alderson E. Boettcher	M. Fortner K. Buckman M. Porter
Psychopharmacalogical Nursing, Lesson II: The Use of the Nursing Process in Psychopharmacalogical Nursing	npharm2s	S. Alderson E. Boettcher	M. Fortner K. Buckman M. Porter R. Skillman
Psychopharmacalogical Nursing, Lesson III: Antipsychotics	pharm3	S. Alderson E. Boettcher	E. Stevens
Psychopharmacalogical Nursing, Lesson IV :	pharm4s	S. Alderson E. Boettcher	R. Skillman E. Stevens
Sample Challenge Exam	nursesamp1	M. A. Early D. Williams Kazmierczak	M. Fortner K. Slaughter
Simulated Treatment of Diseases	simexec	M. A. Early	M. Fortner J. Trueblood

-- PHYSICAL EDUCATION --

Title	Filename	Developer	Programmer
Basic Raquetball Strategies for Doubles Play: Offense	raquet	J. Kent	P. Bayalis
Basic Raquetball Strategies for Doubles Play: Quiz	raqtest	J. Kent	P. Bayalis
Basic Racquetball Strategies for Doubles Play: Defense	raquet	J. Kent	P. Bayalis
Biomechanics Application Problems: The Laws of Signed Numbers	lawsign	D. Barlow	P. Bayalis
Biomechanics Application Problems: Balancing Equations	balance	D. Barlow	P. Bayalis
Biomechanics Application Problems: Formula Transformation	formula	D. Barlow	P. Bayalis
Biomechanics Application Problems: Proportionality	proport	D. Barlow	P. Bayalis
Biomechanics Application Problems: Unit Conversion	unitcon	D. Barlow P. Bayalis	S. Correll
Biomechanics Application Problems: Trigonometric Functions	trig	D. Barlow P. Bayalis	S. Corell
Biomechanics Application Problems: Vector Motion Analysis in Sport I	bioprob	D. Barlow P. Bayalis	S. Correll

Physical Education (continued)

Title	Filename	Developer	Programmer
Biomechanics Application Problems: Vector Motion Analysis in Sport II	bioprob2	D. Barlow P. Bayalis	S. Correll
Biomechanics Application Problems: Pre/Post Test	preptst	D. Barlow P. Bayalis	S. Correll
Biomechanics Digitizing Package: Angle Computation	angled	D. Barlow	S. Hart
Biomechanics Digitizing Package: Area	area	D. Barlow	S. Hart
Biomechanics Digitizing Package: Curve Length	mcurve	D. Barlow	S. Hart
Biomechanics Digitizing Package: Digitizer	digitizer	D. Barlow	Markham Jr.
Biomechanics Digitizing Package: Length	length	D. Barlow	S. Hart
Biomechanics Digitizing Package: Point Plotting	graph	R. Craig	S. Hart
Biomechanics Digitizing Package: Velocity and Acceleration	angacc	D. Barlow R. Craig	S. Hart
Biomechanics Digitizing Package: Du Pont Study	projbit	D. Barlow M. Provost	Markham Jr.
Biomechanics Digitizing Package: No Frills Gait Analysis	gait	D. Barlow	Markham Jr.
Biomechanics Digitizing Package: Projectile	projectile	D. Barlow	Markham Jr.

Physical Education (continued)

Title	Filename	Developer	Programmer
Cartesian Coordinate System	cartesian	J. Richards	J. Richards
Film Motion Analysis Bitpad Version	analbit	D. Barlow	Markham Jr.
Film Motion Analysis Projector Version	analproj	D. Barlow	Markham Jr.
Fitness	fitnes1	J. O'Neill	S. Correll P. Bayalis
Mechanics of Muscular Contraction	muscles	R. Neeves	Markham Jr. S. Hart
MicroPLATO PE Student Signon/Routing System	studdat inst perout time pesystem	D. Barlow R. Neeves S. Hart J. Silver	S. Hart Markham Jr.
Muscle Identification: Upper Extremities	muscle	K. Handling P. Bayalis	S. Hart
Muscle Identification: Lower Extremities	muscle2	K. Handling P. Bayalis	S. Hart
Muscle Identification: Trunk	muscle3	K. Handling P. Bayalis	S. Hart
Nutrition and Exercise Series: Exercise	exercise	B. Kelly P. Bayalis	S. Correll
Nutrition and Exercise: Series: Nutrition	newcal	B. Kelly	S. Hart P. Bayalis
Social Dancing	dancer	J. Pholeric	P. Bayalis
Volleyball Situations	vbaldrill	B. Viera	Markham Jr.
Volleyball Strategies (4-2) (2-1-3)	volleyball*	B. Viera	Markham Jr.
Volleyball Strategies (6-2) (2-4)	vball	B. Viera	Markham Jr.

-- PLATO and OCBI --

Title	Filename	Developer	Programmer
Delaware PLATO System Hardware Configuration	udhard	J. Wilson B. Fortner	B. Fortner D. Anderer
DISCO: Disco Vision Associates Optical Video Disk	discovis	C. Gill	C. Gill
Example of TUTOR Judging Flexibility	udmeow	R. Stabosz	R. Stabosz
How to Read and Write in a Notefile	raeguide	R. Stabosz	R. Stabosz
How to Use PLATO	udhelp udhlp	J. Weissman B. Seiler	J. Weissman
Information on OCBI	udinfo	Hofstetter J. Wilson	J. Wilson D. Graper
The Judging Copy	jcopy	J. Trueblood	J. Trueblood
Judging Copy Examples	jcopyex	J. Trueblood	J. Trueblood
Programming for the Touch Panel	touchhelp	J. Weissman	J. Weissman
System Messages -- Who Sent It and Why	messages	J. Weissman	J, Weissman
Using the Diablo Printer	diablo	J. Trueblood	J. Trueblood
Video Disk Control and Editor	videdit	J. Wilson	J. Wilson

-- PHYSICS --

Title	Filename	Developer	Programmer
A Problem in Angular Physics	udfou	C. Fou	C. Wickham
Positions of the Planets	planets	S. Lamphier	S. Lamphier

-- POLITICAL SCIENCE --

Title	Filename	Developer	Programmer
Committee Chairman (adapted from University of Illinois)	npols8	R. Sylves S. Garton	K. Kahn
Political Districting (adapted from University of Illinois)	npols3	R. Sylves S. Garton	K. Kahn
State Agency Head (adpated from University of Illinois)	npols5	R. Sylves S. Garton	W. Smith R. Smith

-- PSYCHOLOGY --

Title	Filename	Developer	Programmer
Anagrams	anagrams	Berg-Cross Mc Laughlin	J. Sandler
Conservation	clare	C. Berrang	C. Berrang
Direct Scaling	dscale	J. Hoffman	J. Weissman R. Krejci M. Frank C. Berrang
An Experiment in Memory	remember	Mc Laughlin	J. Sandler
Eyepath	eyepath	L. C. Skeen	C. Vinson
Fuzzy & Clear Images	fuzzy	Mc Laughlin	C. Berrang
Geometrical Optical Illusions	illusion	J. Hoffman J. Weissman	J. Weissman R. Krejci
Iconic Memory Experiments	rletters letters	J. Hoffman	J. Green C. Marks

Psychology (continued)

Title	Filename	Developer	Programmer
Memory Experiment	retain	Mc Laughlin	J. Sandler C. Berrang
Mental Imagery	wrmps	Mc Laughlin R. Stabosz	R. Stabosz C. Berrang
The Poggendorf Illusion	pogexp	J. Hoffman	J. Weissman
Reaction Time and the Measurement of Mental Processes	reactime	J. Hoffman	C. Marks
SIMON	simonc	Mc Laughlin J. Wilson	J. Wilson R. Krejci
Visual Perception	eye1	J. Hoffman	J. Weissman R. Krejci

-- SECURITY --

Title	Filename	Developer	Programmer
Criminal Code (PLM Module)	crimcode	S. Swain	R. Schwartz R. Krejci
Motor Vehicle and Bicycle Regulations	sectrain	S. Swain	R. Schwartz
Phonetic Alphabet Code for Law Enforcement	alphdrill	S. Swain R. Schwartz	R. Schwartz
Professionalism	secprof	J. Schimmel	R. Schwartz
Public Safety 10 Code	tencode	S. Swain	R. Krejci
Ticketing	traffic	S. Swain	R. Schwartz

-- STATISTICS --

Title	Filename	Developer	Programmer
Statistics Worksheet Lesson	statone statmod	V. Martuza	A. Olsen M. J. Reed G. Feurer

-- THEATER --

Title	Filename	Developer	Programmer
Interactive Timeline	timeline timedit	B. Hansen	M. Larkin J. Davis J. Wilson

Research Programs

-- ART --

Title	Filename	Developer	Programmer
Statistical Package for Letter Spacing	artstats	R. Nichols	C. Wickham

-- EDUCATIONAL STUDIES --

Title	Filename	Developer	Programmer
Effect of Orthographic Structure on Letter Search	scan	A. Tobin R. Venezky	D. Anderer
Graph Reading	graphs	V. Martuza	J. Trueblood
Lexical Recognition	lexiless	R. Venezky	G. Feurer
Moving Window	window	R. Venezky	D. Anderer
Multi-Dimensional Scaling Survey Package	mdsfix mdsrun mdsedit	V. Martuza	Joseph Maia R. Ozer G. Feurer
Reading Experiment	reading	D. Birkmire	D. Anderer
Recall Pattern Among Autistic and Retarded Learners	recallt	C. Meisel G. Smith	D. Mosby
String Rating	ratedriver	J. Hart R. Venezky	D. Anderer
Visual Perception	vper	R. Venezky	D. Anderer

-- PSYCHOLOGY --

Title	Filename	Developer	Programmer
Binocular Vision Consistent Mapping with Orientation	visbinoc visbidgt visbiort	J. Hoffman	M. Frank B. Nelson
Consistent and Varied Mapping	vstatcvm viscmtrk viscvm viscvmt visvmtrk	J. Hoffman	M. Frank B. Nelson
Consistent Mapping (3 versions)	vstatcmo vstatcm1 viscmb5 visualcm visualdg viscmo viscmx viscmx1 viscmxdg viscmxd1 viscmxpt	J. Hoffman	M. Frank B. Nelson
Consistent Mapping with Orientation and Audio	vstatcma visatx viscmax viscmox visdgx visotx	J. Hoffman	M. Frank B. Nelson
Data Re-formatting Routine	visrdfix	J. Hoffman	M. Frank B. Nelson
Depth Tunnel	visdpth	J. Hoffman	M. Frank B. Nelson

Psychology (continued)

Title	Filename	Developer	Programmer
Orientation Experiments (6 versions)	visualo visualod visualon visualoq visualos visualot visualo2 visualq2 visualto visualtq visualtx vstatso vstatson vstatsq	J. Hoffman	M. Frank B. Nelson
Psych Research Index	varchive visindex	J. Hoffman	M. Frank B. Nelson
Recall Experiment	visualr	J. Hoffman	M. Frank B. Nelson
Statistics Development	vstatz	J. Hoffman	M. Frank B. Nelson
Subject Group Info and Editor	visgroup	J. Hoffman	M. Frank B. Nelson
Varied Mapping	visualvm visualvt vstatsvm	J. Hoffman	M. Frank B. Nelson
Varied Mapping with Probes	visualdt visualpt visual7n vstats7n	J. Hoffman	M. Frank B. Nelson

Utility Programs

-- CIRCLe --

Title	Filename	Developer	Programmer
Catalog Edit and Search Utility	bibledit biblsrch	K. Kahn G. Feurer P. LeFevre B. Sheaffer B. Lewis	K. Kahn

-- EDUCATIONAL STUDIES --

Title	Filename	Developer	Programmer
Grading Utility	vgrader	R. Venezky	G. Feurer

-- INSTITUTIONAL RESEARCH --

Title	Filename	Developer	Programmer
Graph Generating Program	gredit gruse semdemo	C. Pemberton A. Williamson	B. Fortner A. Olsen M. J. Reed

-- MATHEMATICS --

Title	Filename	Developer	Programmer
Gradebook with Personal Information	rongrade	R. Wenger	R. Payne

-- OCBI --

Title	Filename	Developer	Programmer
Basic Skills Data Converter	bslsconv	C. Wickham	C. Wickham
Character Set Checker	charchek	A. Olsen	A. Olsen
Classroom Scheduler Package	scheduse	B. Seiler Joseph Maia J. Silver	Joseph Maia M. Frank
Classroom Schedule Monitor	schedmon	J. Wilson Joseph Maia	Joseph Maia M. Frank
Comprehensive Accounting Analysis Package	caap	J. Wilson C. Wickham	C. Wickham
Equipment Inventory	inv	R. Stradling	Sundermier
Equipment Repair Requests	repair	J. Wilson C. Wickham	M. Laubach P. Smith D. Williams

OCBI (continued)

Title	Filename	Developer	Programmer
Equipment Usage Statistics Package	mstats	M. Laubach J. Wilson	M. Laubach
Full-Lesson Search Utility	lsearch	J. Trueblood	J. Trueblood
Grading Utility	grader	A. Stickney	A. Stickney J. Davis
Group Records Roster Utility	roster rostersys	C. Wickham	C. Wickham
Group Statistics Printer	groupstats	C. Wickham	C. Wickham
Group Usage Data Formatting Utility	gstats	J. Silver	R. Skillman
Index System	indexsys	M. Frank	M. Frank
Information System for Small Documents	infosys	M. Laubach D. Tripp	M. Laubach
Lesson Access Controller	lac	M. Laubach	M. Laubach
Lesson Code Comparer	comparer	W. Smith B. Williams A. Semprebon	W. Smith B. Williams A. Semprebon
Lesson List Manager	leslists	J. Trueblood	J. Trueblood
Memo Editor	udmemo	J. Wilson	S. Markham
MicroPLATO CPU Data Transfer	mtcopy	J. Silver	S. Hart
MicroPLATO Driver for the Bitpad One	mpad	C. Wickham	S. Hart P. Smith
Minder: A Schedule Minder Utility	minduse	M. Laubach Joseph Maia	M. Laubach Joseph Maia
Multi-Plot	mplotter	J. Hoffman	M. Frank
OCBI Logo	ocbilogo	R. Nichols	R. Nichols

OCBI (continued)

Title	Filename	Developer	Programmer
OCBI Staff Schedule Utility	thesched	B. Seiler D. Graper	D. Graper W. Stainton R. Stabosz
OCBI Staff Schedules	mysched	B. Seiler R. Stabosz	R. Stabosz
PLATO Users Survey Package	question	B. Seiler D. Tripp D. Tripp	D. Tripp
Quiz Driver and Editor	quizdr	M. Porter	M. Porter
Simulation Driver/ Editor	simedit	M. Fortner	M. Fortner M. Frank
Site Usage Display Package	skedsum skedchek skedgrop	J. Wilson J. Silver	M. Frank
Terminal Memory Test Routine	ppt	D. Anderer	D. Anderer
Test Driver	multitest	M. Fortner	M. Fortner K. Slaughter
Time Management Utility	tmu2	M. Laubach	M. Laubach R. Stradling
Time Report Form Package	trf	B. Seiler J. Sandler C. Coletta D. Tripp	T. Andrews D. Tripp Sundermier M. Porter
UD Lesson Catalog Package	catalog	B. Seiler D. Anderer	D. Anderer
University of Delaware PLATO Network	udnetwork	J. Wilson	S. Cox C. Gill L. Carson J. Wilson
User Directory	udpeople	M. Laubach B. Seiler J. Wilson	M. Laubach
Willard Weekend Schedule	weekend	M. Porter	M. Porter